THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL.

VOL. 23. Thursday, April 7, 1921. No. 242.

PUBLISHED WEEKLY.

Subscription Terms: 15/ per annum.
Foreign and Colonial, 17s. 6d. per annum.
All Subscriptions are payable in advance.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of

The Foundry Trade Journal,
BESSEMER HOUSE, 5, DUKE STREET, ADELPHI LONDON, W.C.2.

Contents.

	PAGE
Notes and Comments	309
Making a L.P. Cylinder in Loam or Dry Sand	310
Large Electric Furnaces	315
Queries Answered	315
The Co-operation of Scientific and Industrial Research in the Iron Foundry.—Part II.	316
Lighting the Cupola without Wood	319
The Moulding of a Large Dynamo Casting	320
Book Review	320
A Modern German Steel Foundry	321
Economical Puddling	323
Steel Castings of Intricate Design	324
Institution of British Foundrymen	326
Trade Talk	327
Personal	328
Company News	328
Gazette	328
Iron and Steel Markets	330

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN.

LIST OF SECRETARIES—

General Secretary: W. G. Hollinworth, Bessemer House, Adelphi, Strand, London, W.C.2.
Manchester: J. Hogg, 365, Manchester Road, Burnley, Lancs.
Birmingham: F. B. Holberry, 22, Salisbury Road, West Bromwich.
Sheffield and District: W. A. Macdonald, 62, Button Hill, Ecclesall, Sheffield.
Scottish: W. H. Bound, 5, Midlothian Drive, Shawlands, Glasgow.
London: A. Willis, Norfolk House, 324, South Lambeth Road, Clapham, S.W.
Peterborough: H. P. Mason, Prudential Chambers, Peterborough.
Newcastle-on-Tyne: H. A. J. Rang, 2, St. Nicholas Buildings, Newcastle-on-Tyne.
East Midlands: H. Bunting, 17, Marcus Street, Derby.
Coventry: F. H. N. Lane, Queensberry, 2, Dover Street, Coventry.

NOTES AND COMMENTS.

The Re-sulphurisation of Steel.

In a recent issue of the *Blast Furnace and Steel Plant*, Mr. R. J. Weitlaner has criticised a paper which Mr. C. G. Carlisle presented to the autumn meeting of the Iron and Steel Institute, and published in the November issue of the FOUNDRY TRADE JOURNAL. The part of the paper to which Mr. Weitlaner takes exception is an equation, explanatory of the return of the sulphur to the bath should oxidising conditions inadvertently set in. This equation reads:—

$$Ca\ SO_4 + 4\ Fe \rightarrow Fe\ S + 3\ Fe\ O + Ca\ O.$$

Mr. Weitlaner points out that it is doubtful whether calcium sulphate is a stable compound at such high temperatures, and ascribes the throwing back of the sulphur to the revisible equation

$$Ca\ O + Fe\ O \underset{\rightarrow}{\overset{\leftarrow}{}} Fe\ S + Ca\ O.$$

The largest contributory factor for spoiling a highly reducing slag is the introduction of silica from the running of the roof bricks, "which reduces its basicity and destroys its reducing capacity." Mr. Weitlaner puts forward the following equation as being explanatory:—

$$2\ Ca\ C_2 + 3\ SiO_2 + 3\ Fe \rightarrow 2\ Ca\ O + 3\ Fe\ Si + 4\ CO.$$

We consider that the fundamental principle at the root of all desulphurising is that "like dissolves like," and a metal will dissolve much of its own sulphides and little foreign sulphides. Generally speaking, a bath of iron or steel will retain the sulphur only so long as the sulphur exists as ferrous sulphide, and should manganese be added, manganese sulphide is formed, passes out of the metal, and reduces the sulphur content of the bath. Manganese sulphide is not quite insoluble, and, rougnly speaking, the amount left in will be governed by the following considerations. The temperature conditions and the composition of the slag being fixed, the amount of manganese remaining in the metal multiplied by the sulphur content will give a product which is constant, and can be designated the co-efficient of solubility. Taking the conditions to be 0.6 per cent. of manganese and 0.06 per cent. of sulphur, then the co-efficient of solubility will be 0.036, then to bring the sulphur down to 0.02 per cent., the manganese must be raised to 1.8 per cent., which normally is too high, and interposes a limit to the desulphurising by manganese. Pursuing this theme of "like dissolves like," calcium sulphide is completely insoluble in steel, to which it is totally dissimilar, but is highly soluble in a high-lime slag. It is in this manner that desulphurisation can be so completely carried out in the electric arc furnace. Should steel have been adequately desulphurised and the sulphur fixed as calcium sulphide in the slag, care must be taken not to let it react with any ferrous oxide in the slag, or the reaction put forward by Mr. Weitlaner will take place, resulting in the formation of ferrous sulphide, which should immediately be absorbed by the bath. As the reaction between calcium sulphide and ferrous oxide is reversible, it never proceeds to completion, and so long as the slag contains both, then ferrous sulphide and lime will also be present. Equilibrium will be established when

$$\frac{Ca\ S \times Fe\ O}{Ca\ O \times Fe\ S} = \text{Constant.}$$

This so-called constant varies with the temperature—a high temperature favouring the formation of calcium sulphide. But whatever the temperature, obviously the more ferrous oxide the more ferrous sulphide. Thus it follows that if a slag carries ferrous sulphide so must the metal, or, in other words,

$$\frac{Fe\ S\ \text{in metal}}{Fe\ S\ \text{in slag}} = \text{Constant.}$$

From this it follows, if the slag contains ferrous oxide, the metal will contain ferrous sulphide other conditions being fixed. Therefore

$$\frac{Fe\ O\ \text{in slag}}{Fe\ S\ \text{in metal.}} = \text{Constant.}$$

Therefore, to desulphurise completely the metal, the slag must be free from iron oxide.

From the above the difference between the basic open hearth and the basic electric arc furnace is manifest, as in the former it is necessary to carry somewhere about 15 per cent. of ferrous oxide to retain the phosphoric acid.

The Foundrymen's Competition.

Owing to the difficulty of deciding which designs merit the prizes, we have sought the advice of Mr. Matt. Riddell, the President of the Institution of British Foundrymen, which has delayed the publication of the result for another week.

Making a L.P. Cylinder in Loam or Dry Sand.

By "Ben Shaw" and "James Edgar."

When the steam turbine was first introduced for marine propulsion there were many engineers who thought that the day of the old type of reciprocating engine was over and that all types of vessels, from the slow cargo boat to the ocean greyhound, would soon be fitted with some form of steam turbine. That has not taken place nor is it likely to take place. There are several reasons why reciprocating engines are still popular for driving ships, and even the reduction gearing of turbines will not affect that popularity. The initial cost of the reciprocating engine is less, and the lower comparative cost for running at ordinary speed are two of the important considerations in its favour. But the growth of the turbine has interfered in many

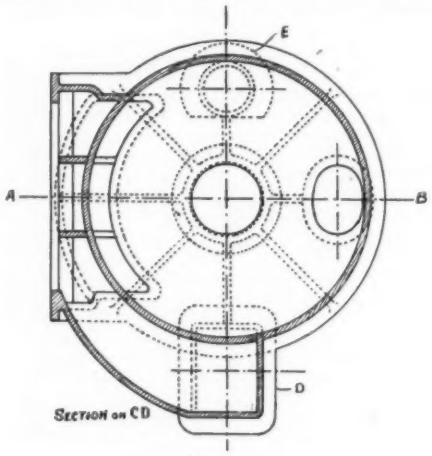


Fig. 1.

foundries with the efficiency of both patternmakers and moulders in the making of work of this character, because works that specialise in high-speed passenger steamers are only concerned with turbines. Thus many patternmakers and moulders, first-class craftsmen, too, have not had the opportunity of getting experience in sweeping up large cylindrical moulds. For this reason the writers of this article believe that a descriptive article explaining the best methods and practice for obtaining such castings may be of value.

It is customary and advisable to set down at

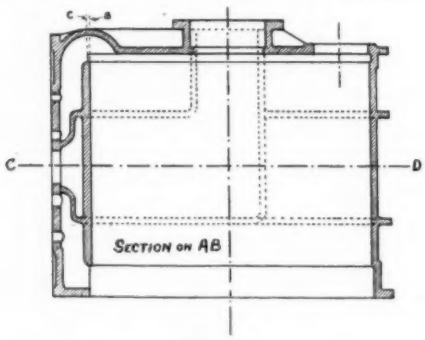


Fig. 2.

least two views of an L.P. cylinder before starting the construction of the pattern work, and the two most useful views are those shown in Figs. 1 and 2. Other lines may be set down as required, and at least ¼ in. allowed on machined faces. Apart from this allowance it is advisable to back up the flanges in case the casting does not contract as much as is allowed for, it is better to have these flanges thicker rather than thinner, so that any additional machining necessary will not reduce their strength. As much as an ⅛th of an inch is frequently added to the back of the flanges for that purpose. The contraction allowance for work of this kind varies considerably in different foundries, but the more general practice is to allow 1/10th to the foot for the diameter and ¼ in. to 3 ft. for the height. After the job has been set down, a length rod should be made. This will not only be found useful while making the pattern, but invaluable for testing centres when setting off the work in the foundry. In some pattern shops these rods are prepared before the drawing is set down, and there is much to be said in favour of the practice, as it saves a good deal of time when the contraction of different parts vary. All the important dimensions should be marked on the rod, the heights on one side and the widths on another.

Many small cylinders, such as winch and pump cylinders, are jointed longitudinally, but both because it is more convenient for coring and also because uniformly sounder metal is obtained,

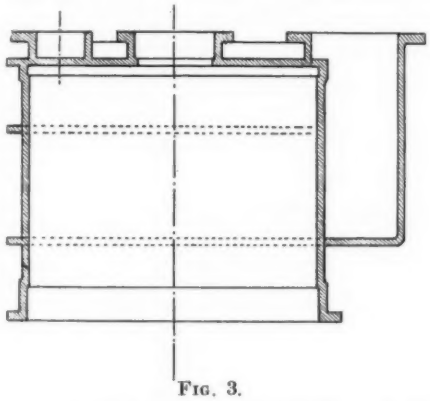


Fig. 3.

marine cylinders are invariably moulded and cast on end. It used to be customary to cast these cylinders with the closed end down, and in many districts the practice is still resorted to, but it is not nearly so convenient from the patternmakers and moulders' point of view, now the practice is more general to make them crown up unless the cylinder has a double crown, when it is preferable to cast it crown down in order to carry a head of metal at the open end to ensure sounder metal. With ordinary care in the preparation of the mould sound castings are obtained by having the closed end cast up.

Broadly speaking, there are three ways of making marine cylinders. A wood pattern may be made, a loam pattern can be swept up with the aid of

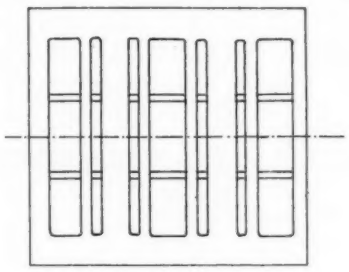


Fig. 4.

boards supplied by the patternmaker, or the cope may be swept out. The first method is undoubtedly the best for cylinders of small bore or short stroke, or even for a large cylinder if a considerable number of castings are wanted, but it is too expensive both in timber and patternmakers' time if one or two castings only are required. Excepting for the standard type of cargo vessel, whose engines were standardised during the war, usually one and at most two castings are required to one design, that is for a single-screw or a twin-screw ship. The practice of sweeping-out the cope was used more frequently twenty years ago than it is to-day, and when that was done it was very common practice to have the closed end of the cylinder at the bottom of the mould. It is considered much better to make a loam pattern or dummy for a large job,

and there are several good reasons for adopting such a method.

Even if a mould is very large, and there is plenty of room for the moulder to get inside, sweeping out a cope is a slow job. Besides it is usually necessary for a patternmaker to be in attendance practically all the time the sweeping operation is in progress to locate the subsidiary pattern work, such as the chest, feet, exhaust branch, bosses, etc., and it is very difficult to ensure accuracy.

We shall not describe a wood pattern here as not many difficulties are presented by its construction, and we shall only lightly deal with the method of sweeping out the cope.

Figs. 1, 2, 3, and 4 illustrate a very common type of L.P. cylinder. There are variations of the design; for instance, instead of a top flat-plate of

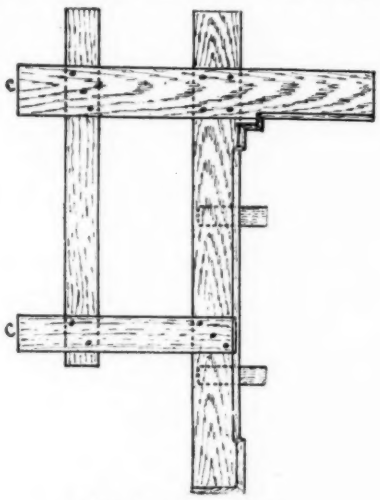


Fig. 5.—Cope Board.

metal some cylinders are conical, but the principles of construction are not really affected by these variations of design. In describing the patternmaking for the job, we shall leave the boards and boxes for the cores until we have constructed the pattern work to avoid possible confusion.

When, in the course of this article, the top of the cylinder is spoken of the open end is meant. This explanation is necessary, because it has become so customary, in some districts, to mould the closed end uppermost that this end is usually referred to as the cylinder top, and when the closed end is moulded down it is spoken of as an upside down cylinder, probably because the method is contrary to the common practice; to engineers, however, the open is the top of the cylinder.

It may be well to consider the working drawing first. It will be observed that at the bottom end of the cylinder the diameter is enlarged. This is to allow for tool clearance, and it is very important

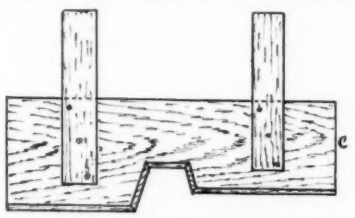


Fig. 6.—Cope Section Board.

to watch this when making the cylinder. It may be mentioned here that the open end of the cylinder will contract more than the closed end, because it is not "held" by the plate of metal and the ribs. In making the core-board some foundries leave normal contraction on the top half of the cylinder, and taper off from the centre line, leaving no contraction on the closed end. Fig. 1 is an inverted plan of Fig. 2, and it will be seen that the exhaust core is a rectangular sectioned belt against the cylinder joining the column feet and exhausting through it. This is made clear by Fig. 3, which is a section across the foot. The various openings in the steam chest are readily seen in Fig. 4, which also shows the strengthening ribs which divide the ports. It is common practice for the patternmaker to introduce two or three ribs across the port openings to facilitate the running of the metal.

Fig. 5 shows a suitable cope board. These large boards should be made of 1½ in. timber at the least, as the best results cannot be obtained with a yielding board. The end C of the horizontal piece is the centre of the mould, or rather the distance to the centre minus half the diameter of the vertical spindle used. It is customary to use a machined spindle of 2½ or 3 in. diameter for large work of this kind. In making the board the vertical and horizontal pieces should be half-lapped together, and then the cope outline drawn. A very contentious matter with loam boards is which side of the board should be chamfered. It, of

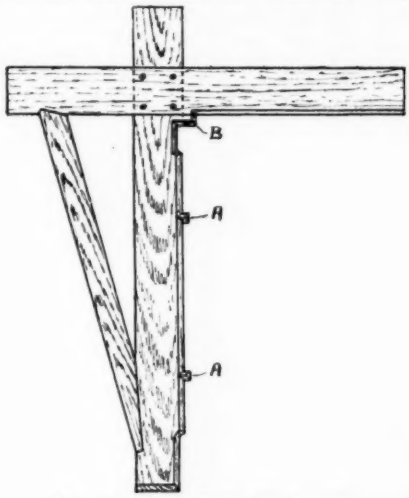


Fig. 7.—Loam Pattern Board.

course, depends upon whether the board will be pulled with the left hand and the loam applied with the right, or *vice versa*, and the individual preference of the moulder or the foundry should be considered. Before the outline is sawn a supporting stay should be secured to the lower end of the board, for a cope board it is preferable to use a horizontal piece, the end being cut accurately to fit against the spindle. This is abolutely necessary to prevent the vertical board being pushed back when the moulder is sweeping out the mould. The "finger" or bearance piece for the ribs should be made of hard wood, about ½ in. thick, and very securely screwed to the board. Better even than screwing them to the face of the board is to cut a recess in the face and set them in, but this involves more labour, and is consequently usually dispensed with. Under no circumstances should glue be used on boards or patterns that are being made in loam. When sweeping out a cope the steam chest is set in position before the actual

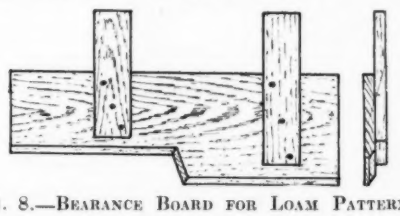


Fig. 8.—Bearance Board for Loam Patterns.

building of the cope is commenced, and the diametrical face which is against the cope, should be cut well clear so that there will be no trouble with the cope-board fouling it as it is being rotated. Moulders frequently prefer to lift the cope after it has been swept, and to provide a suitable bearance and guide a seating board is supplied similar to that shown in Fig. 6. This board is also made to fit against the spindle, the inside part sweeping out a print and the outside a guide for the cope.

The board for sweeping a loam pattern or "dummy" and shown in Fig. 7, is somewhat similar to a cope board in construction. Like a cope board the horizontal top member should be at right angles to the perpendicular edge of the board or the spindle, so that a level may be used in set-

ting it. The stiffener used to support this board is preferably introduced as indicated in the sketch. The extending pieces A A are to sweep recesses in the pattern for convenience in setting the ribs. The sand pattern it must be understood carries all the details just as a wood pattern does, but it cannot be moved conveniently like a wood pattern. The shoulder B is to take out a recess in which a top flange can rest. Sometimes to save fitting up the crown of the cylinder in the foundry a complete half-lapped frame flange is made for the top with the stuffing box and the ribs screwed to it, and this is set on the sand block. Occasionally a recess is swept out of the top of the sand pattern into which the stuffing-box can be located, and sometimes the stuffing is swept with the loam board if it is short. Fig. 11 shows the pattern swept up by the board already described, the bearance having been swept up by means of the seating board, Fig. 8, which also forms a print. The battens on the seating board serve the double purpose of strengthening the board, and at the same time afford facilities for securing it to the tail-piece.

Fig. 9.—Gauge Stick and Irons.

When setting all boards gauge sticks, similar to that shown in Fig. 9, are necessary. They are usually about ¾ in. thick, and may be notched as shown in the illustration, so that the same gauge suffices for setting both core board and cope board, the gauge being tried to the working edge of the board. Sometimes stops are placed on the boards all at the same distance from the centre, and the same gauge is used without any notches being cut. One method is probably as good as another.

A suitable main core-board is shown in Fig. 10. It will be noticed that it is made so that it will sweep out a print or recess for the stuffing-box core. This core is swept up separately by a board similar to Fig. 12. The print may be made the same diameter as the bottom of the core, but generally if the moulder is consulted, he prefers it to be made larger, as shown in the sketch. This

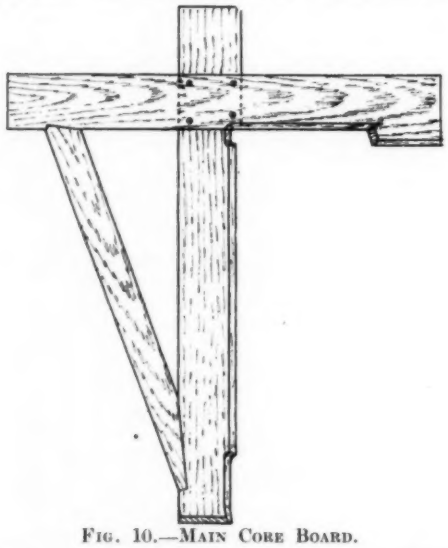


Fig. 10.—Main Core Board.

allows the moulder to use a ring in his main core, with a reasonable size of hole. The advantage of this will be more apparent when we come to consider the actual moulders' work of building up the core and making the mould. The steam-way board which sweeps up the core on top of the main core necessitates an explanation; it is often a source of trouble to the inexperienced. Some foundries sweep out a recess in the main core to the dotted line B, Fig. 2, and make the crown steam-way core so that it drops into this. This is not a very good practice owing to the difficulty of setting the core. A better way, in our opinion, is to joint the core on the dotted line C, making a butt joint. A guide has to be given to the moulder when sweeping the steam-way core on the main core, or he would not know the exact length to make it. The best guide is a thin template made to the exact shape of the bottom of the core, with a centre plainly marked on it for convenience in setting, as shown in Fig. 13.

The boards being finished, which, if the work is in a hurry, will enable the moulder to start his work, the patternmaker has now to busy himself with the steam chest, stuffing-box, and other wood pattern sections. The crown is easily dealt with whether a plate is made or the parts simply set on the sand. Fig. 14 shows the crown complete. The stuffing-box may be lagged up with staves, but

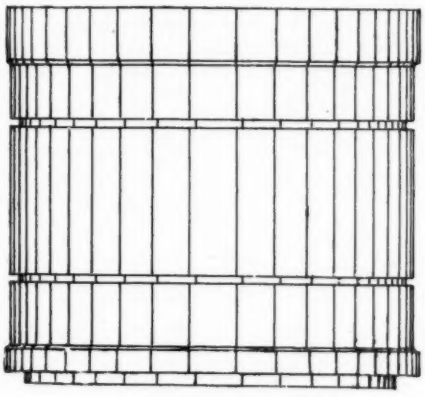


Fig. 11.

if it is not very long it should be built segmentally. Small stuffing-boxes may, of course, be more conveniently made of solid timber. The flange and print may be screwed together and dowelled in position, or the flange may be cut as shown in Fig. 14, with a eye piece to enable the moulder to draw them into the mould if he so desires. The steam-way piece is more easily made as a skeleton pattern. A bottom-plate is cut to the exact shape, and on it are screwed section pieces, 2 or 3 ins. apart, as shown in Fig. 15. The steam chest should be built up with half-lapped frames, as shown in Fig. 16. The number of frames used

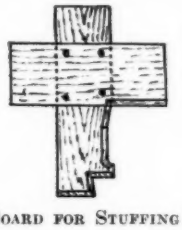


Fig. 12.—Board for Stuffing Box Core.

depends on the size of the chest, as a general rule they should not be more than 18 ins. apart, and they ought to be 1¾ or 2 ins. in thickness. A strong chest pattern is not so essential for a cope job as it does not have to withstand the hard ramming. The half-lapped frames are kept the correct distance apart by means of checked stays (A A A A A, Fig. 16). The sides of the chest may be lagged with

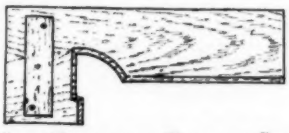


Fig. 13.—Core Board for Part of Steam Way.

1 in. timber. It is the usual practice to make the chest pattern to face and screw the vertical flanges to it, but sometimes it is made to the back of the flange and a special frame is prepared and secured to the face large enough to form the flanges.

Two important parts still require to be made, the exhaust belt and the square foot. Figs. 17 and 18 show alternative methods of making the belt. Fig. 17 shows the shaped plates to the outside. Distance pieces are set between the plates and lagging secured to battens, which are screwed to the inside faces of the plates, so that the outside will follow the contour of the prepared plates. A recess cut about the inside edge of these plates just deep enough to take the lagging makes a stronger

job. Another method is illustrated in Fig. 18, having stays as distance pieces between the plates, but having the lagging screwed or nailed to the outside to give the required shape. Both these methods are used, but, since the belt is to be drawn into the mould, it is preferable to adopt the first method as a better strip will result.

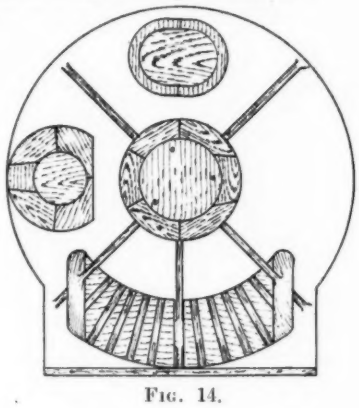


FIG. 14.

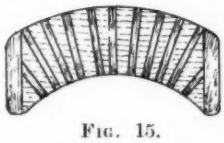


FIG. 15.

The pattern for the foot is simply boxed up, the side which abuts the cylinder pattern not being lagged. The portion of the foot which projects above the top flange of the cylinder, and shown clearly in Fig. 3, should be made as a separate piece, and its correct position maintained by blocks secured to the bottom part, as shown in Fig. 19, over which the boxed-up foot will fit accurately. The flange of the foot is fitted about the outside of the box and screwed. It is necessary to cut this flange conveniently for drawing into the mould. The flanges and ribs about the cylinder are made in segments of convenient lengths. It is usual to fit them to lines on the drawing-board, and keep them

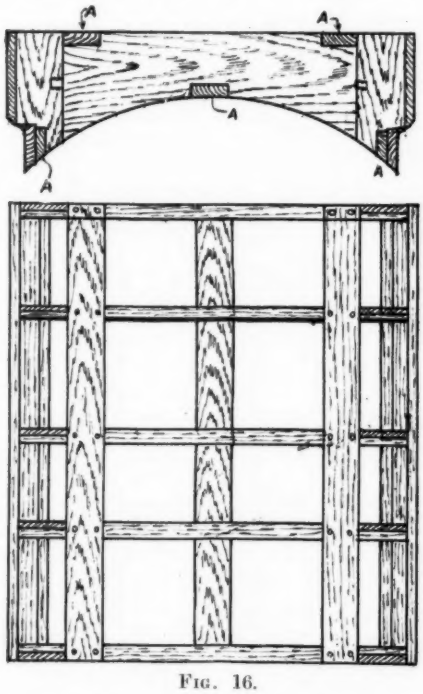


FIG. 16.

rather shorter than the correct lengths, so that there will be no trouble in the foundry when setting up the pattern.

A word or two may be advisable about the prints on the cylinder. Those for the ports on the steam-chest should be about 1¼ ins. thick, and the stuffing-box top print should be tapered to suit the core-board.

The patternmaker is wise to test all the work carefully before it goes to the foundry, and also to screw as much of it together as is possible. The two feet D and E, Fig. 1, and the stuffing-box should be fixed at their correct distances apart by means of two straight edged battens about 4 ins. wide and secured with the edges against the faces.

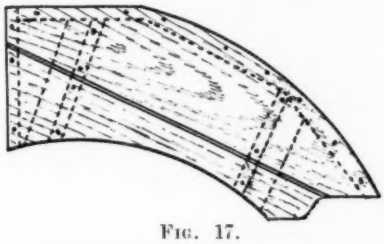


FIG. 17.

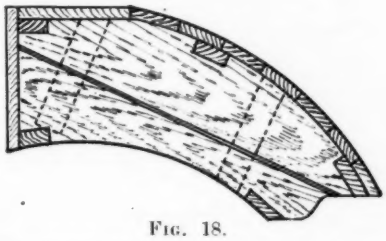


FIG. 18.

In some pattern shops it is customary to rig up the whole of the pattern work as though a solid pattern was made. This method facilitates fitting and checking, but it is not necessary if care is taken unless the branches and ribs are very awkward.

When the moulder has the loam pattern finished and dried, the wood pattern work can be set up.

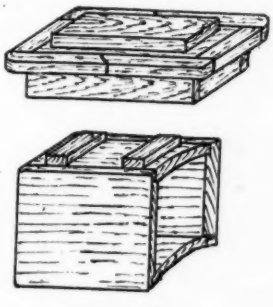


FIG. 19.

The patternmaker marks out the vertical centres just as he would centre off a wood pattern. The chest is the first pattern section to be set on one of the centres, then the feet and stuffing-box sections can be set on the other centre, and tested from the face of the chest to see if they are parallel. The belt pattern may be fixed in position by means of

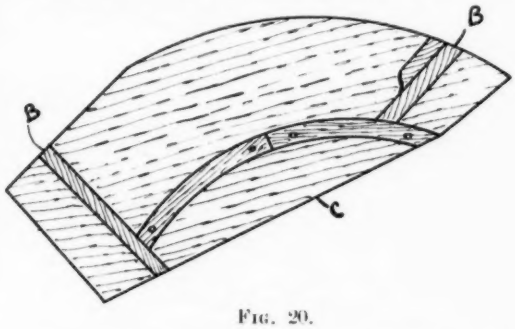


FIG. 20.

temporary buttons or pocket screws to both the steam-chest and the foot.

Fig. 20 is a section of a suitable form of core-box for the exhaust belt. Two outer plates are made first, and strips about 1 in. thick are screwed to them, the top edge representing the core line. The

ends of the box B are now made, and the best job is obtained by recessing them into the sides. In the foundry the edges C rest on the floor, and the moulder or core-maker strickles a bearance for the box. For the patternmaker to make a bottom is to incur needless expense. The square foot core-box should be a framed-up rectangular box with a bottom, and on the bottom circular section pieces

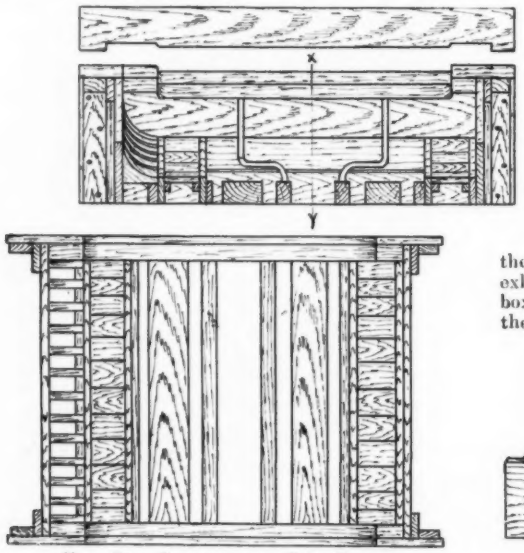


Fig. 21.—Steam-chest Core-Box.

should be fastened about 2 ins. apart, to form the shape of the cylinder against which the core fits. This is really a skeleton bottom. The exhaust belt, the foot core, and the steam-chest core are butt-jointed together. The steam-chest core is rather a big job, but it presents no great difficulty.

Sometimes the inlet and exhaust cores are made separately and sometimes all together in one box. The constructional costs are less when one box is

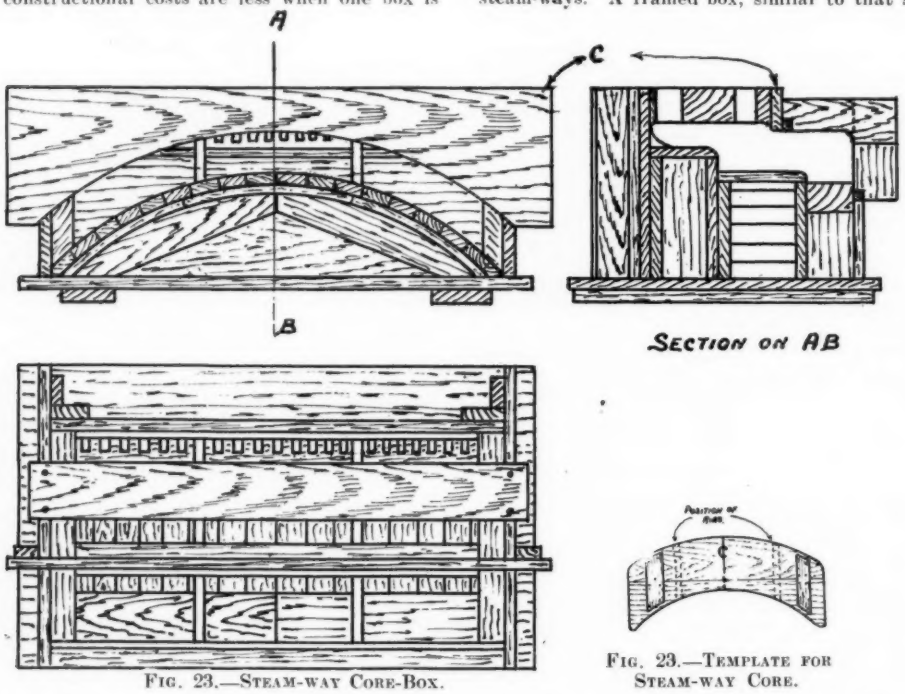
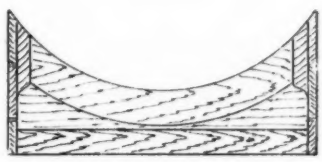


Fig. 23.—Steam-way Core-Box.

used, but delay is caused in the foundry because only one core can be formed at one time, this will be better appreciated when the making of the cores is being described. Three views of box suitable for making both steam-way cores and also the exhaust core are shown in Fig. 21. A large framed box is made first, the sides and ends being cut to follow the metal thickness of the cylinder, as illustrated in the two sections in Fig. 21. The pieces forming the face flange should be carefully let into the sides to maintain the correct positions of the inlet and outlet openings. The lightening parts behind the inlet or steam-ways should be boxed-up as shown, and one end is shaped up with skeleton-pieces to follow the thickness of metal on the crown of the cylinder. The runners R in the sectional elevation are made about ¾ or 1 in. in thickness, and a width equal to the thickness of the metal forming



the division plate between the steam-ways and the exhaust. Three strickles will be supplied with this box, the one included in the illustration for giving the shape of the cores, which come next to the

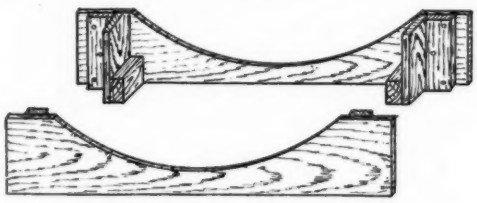


Fig. 22.

cylinder, and two strickles formed as one for strickling out the division plates, using the runners as guides. The ribs are not indicated on the sketch for obvious reasons, they are easily located, but a reasonable clearance should be given them to allow the strickle to pass them. In addition to this box there is a small box for the lightening cores between the chest face and the back of the steam-ways. A framed box, similar to that shown

Fig. 23.—Template for Steam-way Core.

in Fig. 22, will suffice, having two pieces introduced to continue the internal flanges.

Some foundries prefer to have separate boxes for the steam-ways and exhaust, as it enables all the cores being made at one time if desirable. Three views of one of the steam-way core-boxes are shown in Fig. 22. This box is best built on a bottom board, having a back and two sides framed together and the inside shape supplied by boxed-up sections, as indicated in the section on A B.

The squared part of the core which comes next to the flange face, is cut off by the front piece C, which is shaped to the top of the core. Runners are attached at two places for a strickle to form the rest of the core, as shown in the sketch. The method of constructing the exhaust core-box is shown in Fig. 24. A framed box is made to the largest part of the core and sectional pieces are introduced to give the true shape of the required core.

The section on C D gives a clear indication of the pieces necessary, and it will be noted that the ribs are shown in both these illustrations, so that a clearer idea of the finished core-boxes may be formed.

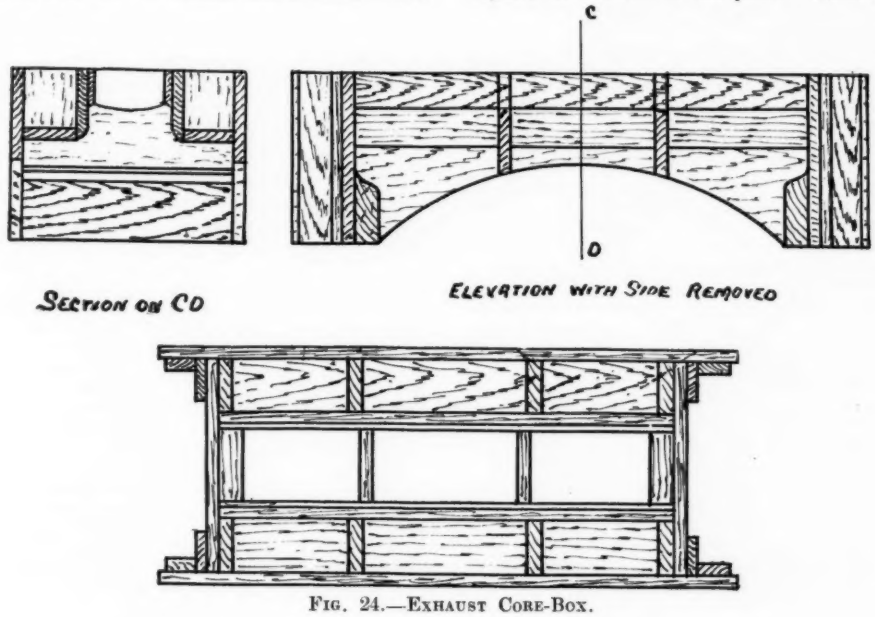


Fig. 24.—Exhaust Core-Box.

Large Electric Furnaces.

According to a recent issue of "The Iron Age," the United States naval ordnance plant, South Charleston, W. Va., has recently put into operation two 40-ton Heroult electric furnaces for refining and finishing steel for gun forgings, armour plate, armour piercing projectiles, and other high-grade miscellaneous forgings for the Navy Department. These are the largest electric melting furnaces in the world.

Two 75-ton basic open-hearth furnaces are used in conjunction with the 40-ton basic electric furnaces for duplexing the molten bath of steel. Scrap and pig-iron are melted down in the open-hearth furnaces, using natural gas as fuel, and after dephosphorising, the bath is transferred to the electric furnaces, where it is desulphurised, deoxidised, final additions made and suitable temperature obtained before casting.

The electric furnaces are tilting, of the 4-door Heroult type, basic lined, and have steel shells with diameter, unlined, of 18 ft., and height of 8 ft.

The furnaces operate on a 3-phase, 60-cycle circuit at 90 and 110 volts. Power is received through a 3,300-k.v.a. water-cooled transformer from a 6,600-volt primary circuit. Each transformer is located on the charging floor, directly behind the furnace which utilises the power. Normal demand of these furnaces is between 1,500 and 3,000 kw. each.

The furnaces are situated well out in the pouring bay of the open-hearth shop, and have a spacious platform surrounding them, and also a tilting platform in front of each. A large casting pit, built for use in teeming the ingots, is 30 ft. wide and 150 ft. long; one portion of it is 16 ft. deep, and the remainder 8 ft. deep. This pit is also used for burying ingots in ashes.

With the equipment provided, it is possible to make individual ingots up to 175 tons in weight. This is the maximum size required for the present-day armour plate and gun forgings.

The naval ordnance plant is also equipped with three 6-ton Heroult electric furnaces, which are used in making small-calibre gun forgings, projectiles and steel castings for maintenance and repairs for the rest of the plant. These furnaces are used in melting down cold scrap. Each furnace operates on between 800 and 1,200 kw.

A 1-ton Heroult furnace, basic lined, has been purchased and is ready for erection, to be used in the manufacture of tool steel and experimental work on new alloy steels.

Queries Answered.

Casting Small Castings from Large Ladles.

2a.—When teeming small steel castings from a bottom-pouring ladle we find that the velocity of the stream cuts the runners and gives dirty castings. On the other hand, if we shank much heat is lost, accompanied by cold-shuts and slag in the castings and usually skulls in the ladles. A good deal of time is lost through skimming. What would you suggest?—"G. L."

2b.—An obvious method of reducing the velocity of the stream is to suspend a tundish below the nozzle, but usually this is an awkward arrangement, and we would advise our reader to convert the ladle into a "tea-pot" type. This can be accomplished by the construction of a refractory bridge at the back of the teeming spout in such a manner as to keep back the slag at all angles. There are two designs of "tea-pot" spout ladles on the market, the one having a separate compartment built outside the normal shell of the ladle, and the second virtually as described above. The former we would not advocate on the grounds of dearer construction and increased surface area which coincides with larger radiation losses. The latter construction can be effected by the fitting of two channels vertically at either side of the spout in the interior of the ladle. These should be so arranged as to carry standard firebrick slabs. After bricking the ladle, a good layer of ganister or compo should be given and the whole very thoroughly dried before use. We shall be glad to hear any of our readers' views on this subject.

Melting Cast-Iron Borings.

C.1.—We shall be pleased to hear if it has been found practicable to melt up cast-iron borings for making run down pig-iron for use, and if such a scheme is practicable, and what difficulties have to be overcome with regard to melting such material down in the cupola.—Omo.

The Co-operation of Scientific and Industrial Research in the Iron Foundry.—Part II.

(*Continued from page* 290.)

By Thos. Vickers, Secretary of the British Cast-Iron Research Association.

No scheme of scientific research will succeed unless it has the co-operation of the workpeople themselves. The co-operation of science to the foundry will mean changes; these can only be carried out if assisted by, and have, the support of intelligent workmen. Workmen might not be able to bring to bear profound scientific knowledge or any scientific knowledge, yet they could bring forward the difficulties of their work and point out the effect of various conditions not only upon the processes, but also upon the conditions and the efficiency of the worker. There is no reason at all why the foundry hand should not be of the same status as any other branch of engineering work.

Before the iron age there was the great and beautiful sculptures reproduced in bronze, typical examples of the early moulders' craft, and the present-day moulders, from a craft point of view, are actually descendants from them. But the casual way in which labour is allowed to drift into the foundry, whether fitted for it or not, is of no use to the industry, and must be altered. A trained and intelligent workman who takes a live interest in his work is able to produce better finished work —other things being equal—than one who has not received any training, and he takes greater interest in the principles underlying all the processes of the work he carries out.

There is practically at present in this country no universal system of training for foundry youths —America, France, Belgium and Germany have a thorough system. It is to the interest of all foundrymen to insist upon such a scheme being carried out by the Research Association that shall ensure a supply of skilled men, to keep up and improve the best traditions of the foundry in respect to the quality of its products. Such a scheme can be carried out by the Research Association as representing the voice of the industry.

This labour question and the amenities of foundry life must not be ignored, as the consequence of further neglect will have a serious effect upon the engineering industry; it will not only keep out of the trade the superior type of workman, but it will cause further emigration of moulders from the foundry.

No one will deny that some of our foundries have undergone little or no improvement during the past 20 years, many are conducted on lines wholly empirical, many are under the control of people who do not yet comprehend the principles governing manufacturing operations. The foundry, more than any other industry in this country, must improve along evolutionary lines. Fractional parts of a penny saved in the cost of production will become important, waste must be cut down, and new commodities from it evolved.

During the war the Government made an inspection of a large number of foundries, and, in an exhaustive report by Dr. W. H. Hatfield, of Sheffield, he made some astounding statements as regards their condition. Speaking of the malleable cast-iron foundries, he reported:—

"There is a general lack of knowledge on the part of many engaged in the industry, a proportion of the manufacturers have failed to acquaint themselves with the scientific work already published dealing with matters concerning their industry. There are, however, a number of more enlightened firms whose practice is in line with standard knowledge. *There are quite a large number of firms who still conduct their operations without the least appreciation of scientific principles, and are working by 'rule of thumb.' The number of laboratories is very small indeed.*"

Such a report might be applied to an investigation made a century ago, and makes an extraordinary indictment against the lack of any scientific co-operation. After all, increased production is what the ironfounder runs his foundry for. Increased production is necessary to him, but no one yet has solved it by leaving out of the calculation the co-operative power of science. Foundry competition is widening very much, large new foundries are being built upon very modern lines in Belgium and Holland, two countries who believe in the absolute value of scientific research to their industries. These new foundries are, it is stated, being built expressly to capture the iron-casting trade required by the British engineering industry. Recently a large Scottish firm placed an order in Belgium for 1,200 tons of iron castings at 28 per cent. below any English firms, with guaranteed deliveries and guaranteed physical tests. Malleable iron castings are being delivered from Belgium at the present time into Birmingham, the centre of the malleable industry. The makers of gas engines in this country are finding themselves unable to meet American competition in neutral markets. As you know a large part of the total costs of production lie in the cost of the castings, America with her up-to-date methods can produce castings at a lower cost and also lighter, which means freight saving. What, therefore, is required to improve our position?

The present position is, no doubt, one of the results of the great secrecy with which foundries have in the past carried out their work. That is now being broken down by the meetings and discussions of the Institution of British Foundrymen. A Paper was recently given in Birmingham upon "The Making of Cast-Iron Rolls," which was probably the first time such a subject has been openly discussed, and we have now The Foundry Trade Journal, published weekly, which will prove a great help to foundrymen. Secrecy is only a mask for ignorance; not only must this be broken down, but the engineer and the user must be educated as to the possibilities of our material.

The Malleable Cast-iron Section of the Trade.—In this country there are about 170 foundries against over 300 in America. These turn out 66,000 tons per annum against America's 1½ millions. In the Midlands there are 120 malleable foundries, London and the whole South Coast have about nine, Wales has none. Malleable cast iron in America is most extensively used for engine parts, mining gear, cranes, hydraulic work, machine tools, automobile work, for stoves, ranges, railway work and countless other industries. There is no branch in engineering, using the term in its widest sense, in which malleable castings cannot be used to advantage. As scientific research progresses it is quite certain that the field for malleable work will be enormously widened, and the true legitimate field of grey iron will be restricted to the production of that size of castings that cannot be successfully produced in malleable. This is the position the American foundries are finding at the present time. They have found as a result of their research that malleable castings can and are being made of thicker sections hitherto undreamt of. The average ultimate tensile strength of grey-iron castings is about 10 tons per sq. in., associated with no ductility. As a result of the American Research Association they are producing malleable castings in the region of 24 tons per sq. in. with an elongation on ½ in. of 12.50 per cent. Suppose castings were made from these two materials to perform the same function, and each design being based upon their respective physical properties, the malleable casting can safely be made one-third lighter than the grey-iron casting. This difference in weight will counterbalance the difference in cost per pound, freight charges will be less, and it has a more pleasing appearance when assembled. This is no theoretical statement, malleable work is rapidly replacing grey iron in other producing countries where the full value of scientific methods has been appreciated, and this section of the trade has taken full advantage of it.

The same line of reasoning can to a certain extent be used in the field of steel castings. There is hardly a limit to the size and weight of steel castings, but malleable castings are singularly free from blow-holes, whilst this is one of the shortcomings of steel castings. If rust-resisting properties

are required for any work, malleable castings have the superiority over steel.

Further, as the result of progress in the mechanical world there is an ever-growing demand for small castings, they are an absolute necessity for the economical production of machinery. Malleable iron castings fill this requirement better than any any other class of castings. Experiments are also being carried out in America to adopt malleable castings for toothed wheels for machinery, and there is no doubt that they will find the means to produce a really tough metal for these large castings.

It is somewhat remarkable that to-day America is proud to say that through her research work they find it quite easy to make malleable iron castings in sections 1¼ in. thick, yet we have records that in 1865 malleable iron castings were made in Scotland by an ironfounder called McHaffie up to 6 in. thick, and weighing several thousand pounds. McHaffie made gears, crankshafts, valves, etc., of his malleable cast iron; he was a founder who co-operated the scientific spirit with his work. He was a very progressive man, and was always adopting new methods. But he kept his process a secret, and it died with him. There are no records of McHaffie's work except that it is known that he always annealed his castings for two weeks, which included the time required for heating to the annealing temperature and cooling. A piece of McHaffie's malleable iron was recently analysed as follows:—Total carbon, 2.71; graphite carbon, 1.87; combined carbon, 0.84; silicon, 0.98; sulphur, 0.49; manganese, 0.02; phosphorus, 0.063.

When the great cycle boom took place some years ago, followed by the motor cycle and motor car booms, malleable cast-iron parts were used in enormous quantities; indeed, it is said that these three successive booms placed the industry in this country on its feet. As these trades slowed down greater care was shown by the cycle manufacturer in the examination of the castings supplied; the quality was found to be so faulty and poor that drop steel forgings soon superseded them, and have held the first place ever since. To-day there are similar complaints, and engineers are adopting mild steel castings to a larger extent than hitherto, heavier castings are also being used, because the faith in light malleable iron castings has been somewhat disturbed.

The Scope of the Research Association. — The malleable side of the industry has been discussed at such length because, as the author is the Technical Secretary of the Cast-iron Research Association, he has to watch the trend of production in this and other countries, and he believes that a great future lies before it, and that in time this country will once again take its position as one of the leading malleable producers. The Council of the Research Association intend to vigorously pursue an immediate investigation and research into this branch of the industry, and already valuable data have been collected fron America and other countries, but it is not intended to merely investigate the economic position of the malleable foundries, but, *in the first place*, to conduct a general scientific research on the materials and methods provided by the industry, with the primary object of increasing our knowledge of facts. By this method some point will be arrived at where there is a vacuum of scientific knowledge, and fill up the vacuum with newly-discovered facts and principles in the expectation that this new knowledge will provide us with a new practical problem at which to work. *In the second place*, alongside with this work there will be carried out research into problems that arise in the course of every-day manufacture, and subject them to organised investigation by scientific methods.

About the grey cast-iron section very little will be said. The 2,800 foundries in this country are composed of a large number of small foundries. It is at times suggested that cast iron is in danger of being superseded by steel or wrought iron, and that the grey casting industry will disappear, which statements cannot be substantiated. Since 1850 the use of cast iron has been gradually abandoned for constructional purposes, but so many other applications have been found for cast iron that the trade is in no danger of extinction unless it be by its own inertia. Engineers should remember that cast iron is the cheapest and most abundant form in which metal is met with in commerce, some trade has been lost, and no doubt non-ferrous metals by die-casting will capture some more, but one can rightly argue that cast iron is superior for many purposes over any other material. We can make common castings with an average tensile strength of about 7 tons and better quality castings with a tensile strength of upwards of 15 tons. The crushing strength of cast iron is greater than that of any other material, reaching a maximum of about 90 tons per sq. in., the average being about 40 tons. Being protected by a skin, cast iron resists atmospheric influence better than wrought iron or steel, while for wearing surfaces of machinery nothing is superior to cast iron on cast iron so long as sufficient area is provided. Castings are much more easily and sharply produced than forgings, so that the latter need only be employed where special requirements of strength or ductility are necessary. As compared with steel castings, the advantages of cast iron for ordinary uses include not only the cheapness of the original material, but also the lower cost in preparation of the moulds, the smaller loss in casting, and in the saving of expense and time required for annealing. Iron castings can therefore be prepared to meet a pressing emergency, while their fine surfaces and sharp edges recommend them for general use.

Numerous ideas to improve the strength of cast-iron have been put forward, and there is no doubt a very wide field here for scientific research. In 1851 Stirling took out a patent "to produce tough cast iron." After 5 years' research his principles were largely adopted. It is rather singular that there has been a very large number of patents taken out during the past 30 years for improving grey cast iron, many of them forgotten. All these patents will no doubt be looked into by the Research Association.

Carpenter, in 1876, patented in America the use of steel for strengthening cast iron, since which time the use of steel scrap has been adopted in this country for many purposes, and as is well known the researches of W. J. Keep into the physical strength of cast iron—from the standpoint of the mechanical engineer—developing therefrom a contraction system known by his name. Although Keep was not a foundryman or a metallurgist, he left behind him records of valuable data.

Semi-steel.

There is another section of modern foundry work that is gradually gaining favour among some foundries and users, the manufacture of what is termed "semi-steel." The product is called by this erroneous name by those who are not fully informed of its properties. Its importance to the engineer lies in the fact that the ultimate strength is increased very much by adding the steel scrap. The foundryman, however, has a serious problem before him in making this commodity in running these high steel scrap heats. Only the best of cupola practice will yield castings free from blowholes, cracks, etc. It is a product brought out by an American called Seaman, hence its name. Undoubtedly it is a great mistake to call it semi-steel, and it is very misleading. The material without doubt has its uses. So far it is being made upon very little scientific data as to its behaviour, but there is a field here for research, especially if it can be found to make it at all ductile, as then its use would be enormous.

Subjects for Research.

No industry in this country will reap greater benefits by such investigations than the foundry, and no industry requires such work to be done more than foundry work. The following are the subject of continual discussion.

Pig-iron.—In all other countries pig-iron is graded by analysis. America has done so for 25 years, but here the grading by fracture is relied upon. For 16 years this has been a great bone of contention. For the benefit of foundrymen, users, and even pig-iron masters, grading by analysis will have to be carried out. Everyone now realises that although the fracture might be the same in different consignments from any single firm of pig-iron makers, the composition varies to a considerable extent, and corresponding variation results in the castings. This will especially be

XUM

seen in the future when castings made during the war period from poor quality irons land into the scrap heaps, and a serious problem of high-sulphur iron will confront the foundryman.

It is rather singular to state that although in 1849 an attempt was made to ascertain the proportions of the different brands of pig-iron as used by ironfounders, and despite the great advance in our knowledge of the scientific principles which underlie ironfounding, the mixtures used are in many cases still kept as a trade secret.

Melting Furnaces.—In this country we use crucible, cupola, Siemens and air furnaces for melting. In some works there are three of these systems at work. It is very important this question be taken in hand thoroughly.

For malleable-annealing there are furnaces working on gas, coke, coal, coal-dust, natural-gas, and oil, with no uniformity of practice. There is no doubt that in this connection a very great saving of heating power, now wasted, can be saved by a systematic research into the best system.

Fuel.—The quality of coke, the best method of judging, testing or analysing it, whether light or heavy cokes are best, and so on. Many foundries do not keep in mind that inferior coke materially reduces the rate of combustion in the cupola and produces high-sulphur castings.

The Use of the Electric Furnace for both grey and malleable castings. (When using high sulphur-irons electric furnace refining reduces it very considerably.)

Sands.—The preparation of moulding sands, the treatment of sands, testing of sands for bond, grain size, permeability, strength, etc. The thermal conductivity of moulding sands as affected by their chemical characteristics when in service.

The Employment of Mechanical Machinery.—Machine moulding is gaining ground, and should be encouraged.

The Use of Permanent Moulds.—At the present time it is considered that a high-grade cast iron is a suitable material for the dies. Here is a wide field for research.

To Secure Castings from successive heats so that with the same composition they will have the same physical strength regardless of how they are tested is a problem yet to be solved.

Heats are frequently being made that will not anneal properly, but the cause is unknown.

Cupola Malleable requires an annealing heat several hundred degrees higher than air or open-hearth furnace iron—a problem still unsolved.

What is the proper interval at the proper annealing temperature for malleable castings?

What are the exact annealing temperatures for malleable castings that should be used to produce consistently uniform results, with any given chemical composition?

What time intervals should be used on all grades of malleable castings for heating up to annealing temperatures?

The temperature of pouring.

The rate of cooling.

The impurities which might come in or be removed during melting.

Contraction of cast iron when cooling (a phenomenon very little understood).

The growth of cast iron (recent research work in Japan entirely contradicts all the theories hitherto held by other investigations).

The influence of silicon in cast iron.

The influence of sulphur on cast iron, and the additions made for its reduction.

The effect of superheated steam on cast-iron fittings.

Resistance of cast iron to corrosion. (This would open out a field for pumps for ship use.) Numerous tests have been made by the immersion of cast-iron parts in sea water to show that they have completely dissolved.

The effect of working temperatures on parts of internal combustion engines. (This is especially important by the increasing use of the Diesel engines.)

The principles that govern the machining qualities of malleable castings. (A matter that is seriously troubling even the American.)

The question of standardisation of test-pieces and method of mechanical testing.

It will be gathered that the object of discussing the condition of our early foundries and our subsequent progress was to show that the lack of scientific co-operation had retarded the industry to a very serious extent.

There has been a very great advance in some vital matters, but it has only been through the co-operation of science such as the sulphur constant required in certain castings; the actual amount of graphitic carbon; the silicon percentage to resist corrosion by acids, are amongst these.

The cast-iron industry will have to be conducted on the same high metallurgical plane as the steel industry, and every effort made to retain its position as one of the premier industries. Scientific research is the only solution of the difficulties in the foundries, and the only way in which full value can be obtained for our co-operation with science, for one is consequent upon the other.

Conclusion.

There has been a great deal written and spoken during the past three or four years upon research, which has been often used more as a cant phrase dear to educationists, and carrying with it no clear or definite meaning to the workman. We are all, however, now realising that we owe the knowledge of the wealth of the world in which we live, of all the wonderful power that is within our grasp, to scientific research. It has removed our previous ignorance of the properties and powers of the things around us, and has taught us what they are and how they can be used. In those old foundries chance played a large part in the discoveries they made, but chance alone is of no use whatever without we can reinforce it by "*exact*" knowledge.

The employment of scientific methods is a payable commercial proposition, and the best proof of its soundness lies in the fact that manufacturers who have once introduced such methods have never been known to return to the old rule of thumb principles. As foundrymen you have a daily example in the use of the microscope. The inventor, Sorby, was not a metallurgist, but a geologist; but in 1861, after a long, patient research, he found out by accident the possibilities of controlling industrial operations. Sorby, who lived in Sheffield, published his idea 60 years ago, but it lay forgotten and neglected for several years until Martens, a German scientist, revived it, and to-day foundries and steel works all over the world are using Sorby's methods and benefiting thereby.

The foundry problems to-day are so vast and of such variety that is there any firm, or any group of firms, who are prepared to spend the large sums of money necessary to solve them? Even if they did, would they at once publish the results for the benefit of the industry generally. There is only one way whereby this can be done, and that is by the co-operation of all the industry.

The Governments of America, Germany, Australia, Canada, South Africa, Belgium, France, Italy, Japan, Norway and Sweden have all formed associations for scientific and industrial research, and our own Government has followed suit. The movement for the organisation and encouragement of scientific research, with a view to utilising in the best way possible the materials and forces at the disposal of mankind, may therefore be described as world-wide.

In this country the Government scheme provides that any industry, or group of industries, may form an association for scientific and industrial research, to which the Government provide half the cost. Twenty-three of such associations have now been formed for twenty-three industries, and it has been considered that the cast-iron industry should have an association formed for similar purposes.

The duty of these associations is to investigate the whole process of manufacture as it stands, work out the inter-relationships of each phase of the work and the effect of changing the order of procedure—in a word, it must expose the skeleton structure upon which the whole is built.

The Cast-Iron Association has now been launched, and every effort is being made to bring its objects and aims before all those connected with the industry. Birmingham, on account of its geographical centre, was selected as the home of the new Association, but the scope of the Asso-

ciation's activities is *national*, and embraces *all* the foundry industry throughout the entire country.

By means of the Association the systematic development of research and its application to industry will be carried out under the *direct* control of the industry itself, and the co-operation of the firms in the industry will enable research work to be undertaken which could not possibly have been dealt with by individual firms.

The Council of the Association fully realise that the value of research is frequently lost to manufacturers because of its lack of application; therefore, every effort will be made to conduct the research work of the Association in such a way as to enable the full value of the investigations to be infused into works practice.

It might be of interest to mention a remarkable manifesto recently issued by the American Federation of Labour, which records a great progressive spirit amongst Labour itself. They resolved—"That a broad programme of scientific and technical research is of imperative importance to the national welfare, and should be fostered in every way possible by the Federal Government," and gave the following reasons in support of its action:—1. Scientific research, and the technical application of the results of research, form a fundamental basis upon which the development of our industries must rest. 2. The productivity of industry is greatly increased by the technical application of the results of scientific research, and the value of scientific advancement to the welfare of the nation is many times greater than the cost of the necessary research. 3. The increased productivity of industry resulting from scientific research is a most potent factor in the ever-increasing struggle of the workers to raise their standard of living.

Obviously, it is to the interests of foundry proprietors, cast-iron users and employees to ensure that the full co-operation of science be obtained in the industry through the medium of the Cast-Iron Research Association. When the early ironfounders started their industry, science was yet an infant, and they could not invoke its aid. To-day science is healthy, strong, supple and pliant, its aid is being invoked by every country in the world who are bent on expanding their trade. The foreigner knows that English goods have held the pride of place in the world's market, and he intends to fight us with the only weapon he knows we do not yet possess—the co-operation of science with industry. Ironfounders must employ this weapon for their own benefit, since it is vital to the future interests of the industry. Scientific research may be considered by some as an innovation, but it should be tackled along business lines, and approached in a broad-minded spirit. One could then be confident that these will be the forces of industry, science, and education moving forward together for mutual benefit, welfare and prosperity.

AMERICAN FOUNDRYMEN'S ASSOCIATION RESEARCH FUND.—According to the "Iron Trade Review" an announcement was recently made from the office of the secretary-treasurer of the American Foundrymen's Association that a gift of $1,000 has been received from Mr. H. S. Simpson, president of the National Engineering Company, Chicago, to be placed at the disposal of the Association. The amount has been deposited in a savings account known as the American Foundrymen's Association Simpson Fund, and its disposition will be left to the discretion of the directors. Mr. Simpson's gift is in accordance with the movement to encourage research work and to advance the foundry industry which has been discussed at the last two annual meetings of the Association. The nucleus of a research fund was obtained in 1916, when the Cleveland Local Convention Committee voted to give the surplus left after paying all bills to the Association for research. Messrs. Thomas W. and John C. Panghorn, Panghorn Corporation, Hagerstown, Md., contributed the sum of $2,500 to the research fund at the Columbus meeting. The principal and interest of the fund, including the Simpson gift, now totals $3,907.39. This is exclusive of several endowments of $5,000 each, announced at the Columbus meeting, which are to be used for rewarding noted accomplishments.

Lighting the Cupola without Wood

A writer in a recent issue of the "Canadian Foundryman" remarks that the idea of lighting the fire in the cupola by means of an oil burner is not by any means new, but is, nevertheless, in a somewhat embryo state as yet. Those who have adopted the system and become accustomed to its use claim that they would not use anything else.

Most modern foundries are equipped with compressed air machinery, in which case it is small matter to instal the oil-burning equipment, but where no compressed air is at hand a complete outfit which can be wheeled or carried about the shop is an invaluable acquisition to the foundry for various other purposes as well as for lighting the cupola. The device is much the same as the plumber's blow torch but on a larger scale, and instead of requiring refined gasoline as a fuel they will burn the cheapest grade of crude coal oil or distillate, with compressed air under almost any pressure. In lighting the cupola the air tank is placed in front of the cupola and the burner is placed in the trough in such a manner as to throw the blaze through the breast opening into the coke.

In preparing the cupola to be lighted with the oil burner in place of kindling wood, very little change is made from the ordinary course of procedure. The sand bed is arranged in the usual manner. The breast hole which must be at least 4 ins. wide and 6 ins. high must be left open and instead of putting in the kindling wood the coke is put right on the sand bed, but this must be done in a proper manner for the first few inches.

The accompanying illustrations explain themselves. In Fig. 1 will be seen how the first layer of coke should be placed. For small cupolas there is very little to fear, but for cupolas above 40 ins.

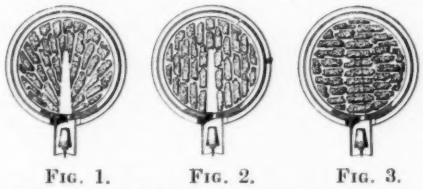


Fig. 1. Fig. 2. Fig. 3.

in diameter, build a tunnel 4 ins. wide and 6 ins. high, starting from the breast hole and extending about two-thirds of the inside diameter of cupola, as shown in Fig. 1. Use large pieces of coke about the size of an ordinary brick, allowing no less than 1 in. space between pieces to allow the flame to spread all over the entire area of the cupola. On top of this layer similar pieces of coke will be placed, but in a manner similar to Fig. 2, lapping over the openings in layer Fig. 1. The openings in the second layer will, of course, be required the same as in the first. The third layer will be cross-wise of the others, and will cover the tunnel as shown in Fig. 3. On top of this the coke is charged just the same as in usual cupola practice.

Tuyeres should remain closed during lighting to prevent counter drafts, and opened when red spots appear around the tuyeres. The oil should then be shut off.

When compressed air type of burner is used, the air can be allowed to continue blowing after the oil is shut off and until the bed is lighted through, after which the breast hole should be closed and the cupola is ready to be put into blast and the remaining charges added.

UNEMPLOYMENT.—According to H. G. Williams, writing in the "Industrial League Journal," out of 1,534,486 Trade Unionists reported upon 6.1 per cent. were unemployed at the end of December as compared with 3.7 at the end of the previous month, and 3.2 a year ago. The figure at the end of December, though high, is substantially lower than at the end of the following years, 1903, 1904, 1908, 1909. Out of 11,900,000 persons insured under the Unemployment Insurance Act on December 31, 1920, 691,103, equal to 5.8 per cent. were unemployed, as compared with 3.7 on November 26. As, roughly, three-quarters of the wage earners are now insured, this figure is a very representative one, and it will now be possible to see fluctuations much more accurately by the use of that figure than the old figure based on returns of certain of the Trade Unions.

XUM

The Moulding of a Large Dynamo Casting.*

By F. H. Bell.

The electric dynamos which the Ontario Hydro-Electric Power Commission will require for the Chippawa Canal enterprise are to be the largest ever constructed, the castings being made at the foundry of the Canadian Allis-Chalmers Company, Limited, Toronto. All told, between two and three hundred tons of castings will be required for each turbine.

The base weighs 45 tons, is 26 ft. in diameter, 5 ft. high, and will be cast in one piece, after which it will be split in two for convenience in handling and shipping. The spider which rests upon this base weighs 100 tons, but is cast in three sections. On top of this are other heavy pieces but not as heavy as these. In Fig. 1 a cross sectional view of the design of the base is shown. It will be noticed that the mould is made of brick and loam bolted between iron plates. In making the mould, no pattern is required, the sweep and spindle shown in Fig. 2 being all that is needed.

Before describing the making of the mould it is necessary to understand that while the base is to be perfectly round it must be cast slightly oblong

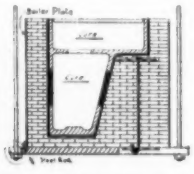


Fig. 1. Cross Sectional View of the Base Mould.

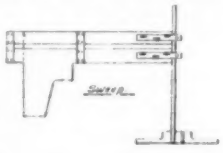


Fig. 2. The Sweep for the Mould Provided with Two Seats.

so that after splitting the casting and planing the joints the base when bolted together will be round. This is accomplished by having two seats for the spindle as shown in Fig. 2. The core prints for the splitting cores are put in their proper position, which would be in line with the space between the two seats of the spindle. The spindle is placed as shown in Fig. 2 and the brickwork at one side of the core prints is built up, after which the spindle

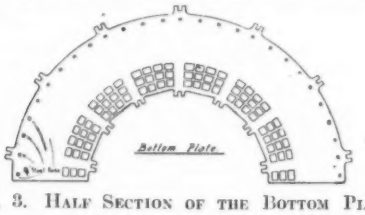


Fig. 3. Half Section of the Bottom Plate.

is moved to the other seat and the balance of the brick work is built.

In Fig. 3 will be seen the bottom plate on which the mould is built. This plate is 27 ft. in diameter and 3 in. thick. It was cast in two halves in the bottom of the pit where the job was moulded, thus ensuring a solid foundation to hold up the enormous weight of the mould and casting. In the plate were cast ¾-in. square steel rods, around the entire circumference of the circle. These rods were to hold the curbing in position as shown in Figs. 1 and 3. In Fig. 3 will be seen the position of the rods which project above the plate about 3 in. This will be seen to better advantage in Fig. 1 with the boiler plate curbing between the steel rods and the brick wall. There are fourteen lugs on each half for bolting down the cope plate shown in Fig. 4. An arbour is cast on the bottom plate. Fig. 3, between the lugs, to carry the brick work up under the overhanging portion of the casting, as shown in Fig. 1, and also to form the inside joint. A grip is bolted to the bottom plate to hold the brickwork secure against damage, particularly when removing the casting from the mould, as this brickwork is to be saved for the next mould. Although the casting runs into the tons in weight it is its size and not its proportions which makes up the weight, as the cross section will only show a thickness of approximately 2 in. The inside is cored out with two sets of cores, one resting upon the other with a partial web between them as a stiffener. The dark portion shown between the casting and the brickwork in Fig. 1 is the loam facing for the mould. This will be seen carried through the casting on both sides. These are to form what are known in foundry phraseology as windows, which are simply oblong openings through the casting about 2 ft. high by 1 ft. wide and distributed entirely around the casting. They are formed after the face of the mould has been swept by placing a frame of the proper dimensions against the wall, and driving a row of nails into the brickwork projecting out the thickness of the casting. The frame is now filled with loam and finished in a similar manner to building on a core, which in reality it is, but this is a cheaper and neater method than pasteing on separate cores. The cores which form the inside of the casting are placed after the mould has been blackwashed and thoroughly dried, these window cores helping to hold them in their proper place.

The cover plate, Fig. 4, not only answers as a cover for the mould but also holds the cores in place as well as acting the part of one jaw of a vice to bind the entire mould together. This plate is placed on top of the mould, Fig. 1, the lugs corresponding with those of the bottom plate,

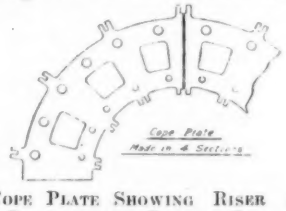


Fig. 4. Cope Plate Showing Riser and Vent Openings and Binding Lugs.

Fig. 2. Twenty-eight bolts similar to those shown in Fig. 1 are required to bind the top and bottom plates together. This, coupled with the boiler plate curbing, holds the mould secure, but as an additional precaution the entire mould is backed up with sand, which is rammed between the curbing and the walls of the pit as well as filling in the centre with rammed sand. Pneumatic rammers are used to ram the sand.

The holes, twenty-four in number, on the outer circle of the cover plate are for the gates. These are connected by runner basin along the top of the mould. They are pop gates, the metal dropping to the bottom of the mould at the perpendicular portion of the mould. The large openings in the cover plates are for the escape of gas from the cores while the small round holes are for risers. The drying of the mould was accomplished by the use of specially constructed iron hanging baskets burning coke. The simplicity of design made specially prepared loam mixture unnecessary, the material used being moulding sand and core binder.

* Extracted from the "Canadian Foundryman."

Book Review.

British Railways and the Great War. Part IV. By Edwin A. Pratt. Published by Selwyn & Blount, Limited, 21, York Buildings, Adelphi, W.C.2. Price 3s. 6d. net.

This book forms a section of compilation, which will be completed by the issue of a further ten fortnightly parts. This particular section deals in six chapters with traffic control and regulation, Ministry of Munitions' transport branch, transport workers' battalions, enlistment of railwaymen and railway companies' steamships.

CALORISING.—Calorising is defined by Mr. A. V. Farr in a recent issue of the "Iron Age" as a patented process of protecting metals at high temperature. It consists in placing the material to be calorised in a retort and heating in a reducing atmosphere, the retort being filled with finely divided aluminium. The treatment, conducted at high temperature, thoroughly infuses aluminium into the exposed portion of the metal, being treated so as to form a homogeneous alloy for a certain depth.

A Modern German Steel Foundry.

In a recent issue of "The Foundry" Mr. Hubert Hermanns describes the Mark Steel Foundry at Wengern, Germany. It turns out open-hearth steel castings and also produces metals and alloys used in refining steel and other metals, and represents an interesting example of a modern post-war German castings plant. In planning the works primary importance was attached to the handling of the raw materials, pig iron, scrap, and fuel. The plant is situated near Wengern Station in Westphalia, on the Hattingen-Hagen railway. The site is comparatively favourable, as it enables the raw materials to be procured within short distances. Fig. 1 shows the general arrangement of the works, which is connected with the railway line by a private siding.

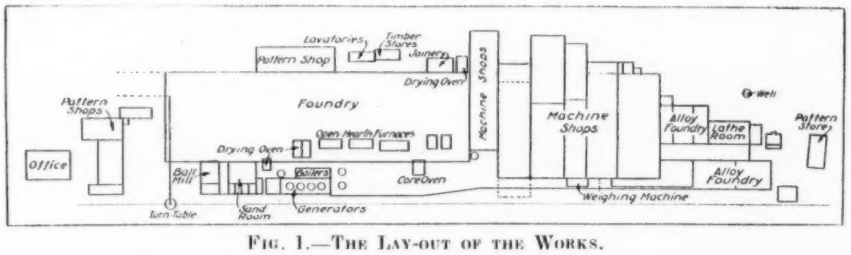


Fig. 1.—The Lay-out of the Works.

The works railway from the main line runs first through the scrap and pig-iron storage yard, where the raw materials are unloaded by a magnet crane. Adjoining the scrap and pig-iron storage yard is the gas producer house, to which is attached a coal shed with bins for storing gas coal. Then comes the sand-preparation room with sand-treating equipment.

The aim of the designer was to minimise the handling of the raw and auxiliary materials. For this reason the cleaning room directly adjoins the main foundry building, while next to it are the machine shops. The sand-preparation room is connected with the foundry building by an aerial ropeway.

The foundry building proper contains three parallel bays with a total length of 493 ft., the centre shop being 59 ft., and those on either side 36 ft. The centre bay serves as a casting house and moulding room; one of the side bays contains the furnaces, the other being used as a storeroom for the flasks. The foundry, the cleaning room, and also the machine shops are amply provided with cranes. In the main centre bay there are two 15-ton overhead travelling cranes together with one of 25 tons and another of 40 tons capacity, so that rapid and economical conditions of work are insured. The side bays contain three similar 10-ton travellers, the cleaning room one traveller of 7½ tons and one of 40 tons capacity. Fig. 2 shows the foundry building in section, and Fig. 4 the ground plan.

The furnace room contains two open-hearth furnaces of 35 tons capacity each, and one furnace of 40 tons capacity, together with two heating furnaces. The furnaces are installed so that they can be directly served by the available lifting apparatus and so they can be charged easily and rapidly. The open-hearth furnaces are charged by an electric traveller of 10 tons capacity, and with a span of 33½ ft. The charging boxes are filled by the magnet crane, which has a span of 65 ft. and a capacity of 10 tons. This crane runs across the iron and scrap storage yard, and is also used for subsidiary work, especially for serving the drying ovens and heating furnaces. The cranes working in the centre bay, of which the 25-ton and the 40-ton crane are used as ordinary foundry cranes, have a span of 57½ ft. At the end of the casting house are the fires for drying the ladles. The centre bay also contains several saws for cutting off risers. The tapping spouts of the furnaces are immediately above the floor level of the foundry, and during the tapping the ladles are lowered into pits. The moulding sand is handled and distributed by an aerial ropeway running along one of the rows of columns and connecting with the sand-preparation room.

The second side bay serves mainly as a storeroom for flasks and also is used for moulding light castings. It is served by two cranes with a span of 33½ ft., and capacities of 5 and 10 tons respectively. Running across the end of the foundry is the cleaning room, which has a length of 192 ft. and a width of 33½ ft. The drying ovens are located on both outer sides of the building; on the opposite side from the gas producer house is a core-drying oven. The pattern shop is completely equipped.

The gas-producer house contains four rotary-grate producers. The boiler house and a blower room to supply steam and air for working the gas producers are built next to the gas-producer house, facing the steel foundry. The gas coal is brought in on a lateral track and shovelled by hand on to the producer platform.

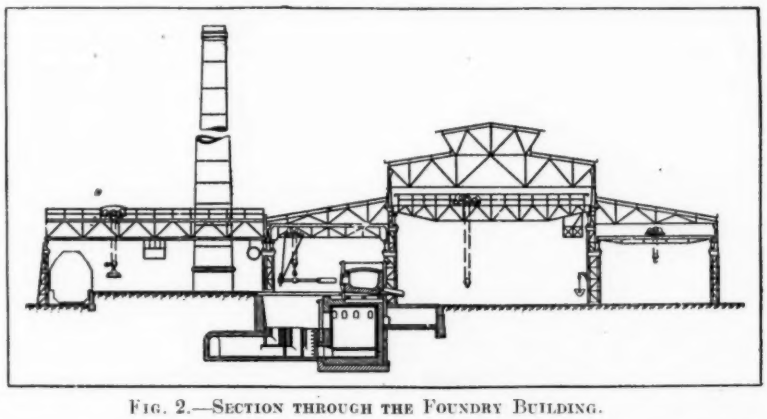


Fig. 2.—Section through the Foundry Building.

The machine shops adjoin the cleaning room. They are mainly equipped for the finishing of large castings, such as machinery housings, ships' parts, etc. These shops contain a number of high-speed, heavy, automatic tools, such as lathes, planing-machines and drills; they are also equipped with the necessary lifting appliances of ample power. The Mark works does not actually construct machinery; only individual parts are made and supplied to engineering works in a finished or semi-finished state.

As previously stated, two of the open-hearth furnaces have a capacity of 35 tons each and the third an output of 40 tons; they are equipped

with regenerators installed beneath the floor level. The furnace hearths are 19 ft. 3 in. long and 8 ft. 4 in. wide. The installation of the furnaces shows no special points of interest. In the formation of the upper part the smallest possible use of refractory bricks and a good flame baffling were aimed at in order to reduce the cost of renewals and repairs. The total capacity of the gas chambers is 725 cub. ft., that of the air chambers 990 cub. ft. Thus, the ratio of the chambers to the air chambers is 1 : 1.4. Between the regenerators and the furnaces, slag pockets are inserted which catch the slag dropping from the ports and the solid bodies carried off by the gases. The furnaces are heated by lignite gas. The reversing gear, with a Siemens valve for the air and Fischer valve with water seal for the gas, is in a vault, the roof of which is formed by the charging platform of the furnaces. By means of sliding valves installed in the connecting channels the flow of the escaping gases can be regulated separately. The two 35-ton furnaces are connected with a common chimney 154 ft. high and 5 ft. inside diameter at the top, while the 40-ton furnace has a separate chimney of similar dimensions to the one described.

The drying ovens, like the open-hearth furnaces and the heating furnaces, use gas fuel. The construction of the drying ovens is indicated in Fig. 4. Their dimensions are 15 ft. by 24 ft. The ovens are heated by two burners attached to one of the walls, while the heat of combustion is regenerated in several flues located below the hearth level and running parallel with the chimney flues. The combustion gases pass through the flues situated below the hearth level close to the door openings.

The gas-fired, heat-treating furnaces, with a floor area 11 ft. by 19 ft., have movable hearths, which are equipped in a similar manner to the drying oven carriages with roller bearings, but with the addition of a layer of refractory brickwork 8 in. thick. The sides of the car are sunk in grooves filled with sand, which protects the heating chamber from the outer air. The gas burners are fixed on one side of the furnace and produce a uniform temperature in the furnace chamber. The air for the combustion is forced at low pressure through a blower into the furnace and regenerated in a regenerator consisting of a number of parallel smoke and air flues. The gas is not regenerated.

The gas-producer building, which is 77 ft. long and 28 ft. wide, contains four rotary-grate gas producers, each 16½ ft. high and with a diameter of 7 ft. 4 in. The coal hopper is charged by hand. The gas, which is distilled from lignite briquettes, has proved suitable for working the furnaces. The average analysis of the gas is as follows:—

	Per Cent.
Carbonic acid	3.50
Heavy hydro-carbons	0.25
Carbon monoxide	32.00
Hydrogen	12.50
Methane	2.50
Nitrogen	49.25
Total	100.00

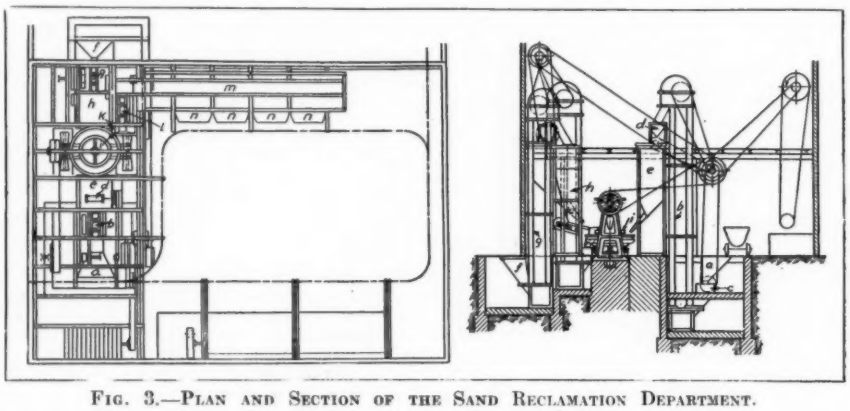


FIG. 3.—PLAN AND SECTION OF THE SAND RECLAMATION DEPARTMENT.

The gas obtained from lignite causes but little dirt in the mains and shows only slight traces of sulphurous acid. The working of the gas producer with lignite briquettes involves little stoking. The gas main is laid above ground and is connected with the generators by an inclined connecting pipe in which a stop-valve is fixed and a dust pocket inserted. The gas-collecting main has a refractory lining and is provided at either end with openings, which can be closed, so as to facilitate cleaning. The gas main also can be cleaned by being burnt out. This is done by connecting it with one of the chimneys of the open-hearth furnaces by a loose bend. A slow moving current of gas is employed so as to obtain gas as free from dust as possible and to effect a separation of the dust carried down in the main flue.

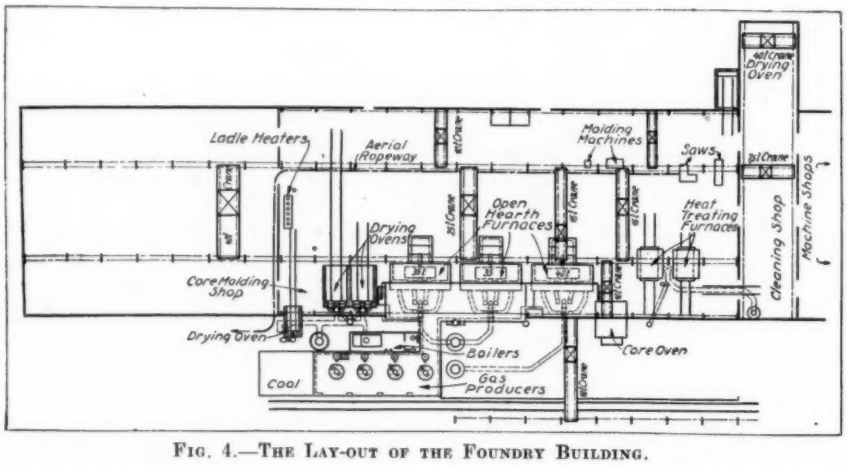


FIG. 4.—THE LAY-OUT OF THE FOUNDRY BUILDING.

The sand-preparing room is connected with the moulding room by an aerial ropeway as previously stated. The fresh sand is shovelled directly from the railway cars into the storage bins as it arrives. The building, together with the storage bins, is 45 ft. wide and 52 ft. long. It is so designed that the work can be performed on the most economical basis. Fig. 3 shows the ground plan and section of the sand-preparing room. The old sand is brought up to the preparation room by

the aerial ropeway and shaken into the boot *a* of the elevator *b*. Beneath the funnel is a roller grinder *c*, which crushes and grinds the lumps contained in the sand. The elevator *b* conveys the sand to the electromagnetic separator *d*, which eliminates iron and steel residues. These are carried by a chute to the foundry floor, while the moulding sand is caught in a container beneath the separator.

The fresh sand, shovelled by hand from the storage bins, is introduced into the boot *f* of the elevator *g*, Fig. 3, and carried by the latter to the collecting container *h*, below which a shaking trough is fixed. The outlets of the two containers *e* and *k* are provided with automatic distributing devices, by means of which the sand can be introduced in a precise proportion into the mixing and grinding machine standing between the containers. In this machine the old and the fresh sand are intimately mixed, ground and crushed, leaving the machine at *i* in condition for use. The finished sand drops through the chute *k* into the elevator *l*, which carries it to the screw conveyor *m*. Beneath the latter are arranged four containers *n*, each of which can be filled independently. They are furnished with outlets provided with round valves. The entire plant is driven by an electric motor.

The Mark plant manufactures steel castings from the lightest to the heaviest description. Castings with a maximum weight of 40 metric tons can be turned out. The castings are moulded mainly by hand, but a few moulding machines also are available, particularly in order to turn out gear wheels, running wheels, and similar articles with the minimum expenditure of time and labour. Pneumatic tools driven by air at a pressure of 100 lbs. per sq. in. are used on an extensive scale for ramming the moulds and for cleaning and chipping the castings.

In addition to carbon-free metals used in refining steel, such as manganese, chromium, molybdenum, titanium, vanadium, and wolfram, the various alloys are produced at the Mark works, for example, manganese-copper alloys, manganese alloys with tin and zinc, chromium-copper, chromium-manganese, chromium-molybdenum, chromium-nickel, molybdenum-nickel, manganese-titanium, ferro-copper, ferro-titanium, ferro-vanadium, ferro-molybdenum, ferro-chromium, etc.

Economical Puddling.

By J. E. FLETCHER, M.I.Mech.E.

The fact that the pig-irons of "forge" quality are nowadays generally the off-products of furnaces working on foundry and basic burdens is of serious import to the makers of puddled iron.

The variable analyses and the highly silicious and phosphoric nature of many "forge" irons today is making the work of the puddler more and more laborious, resulting in puddled bars of anything but uniform character.

Moreover, the fuel consumption due to prolonged melting and rabbling periods and to the necessitous use of large amounts of fettling oxides is often twice that which was demanded in the old days when "refinery" or plate iron was used in the charge.

Towards the standardising of the metal required for puddling and the production of an ideal puddling iron, a method has been evolved and patented by Messrs. Fletcher & Jackson, of Dudley and Lowmoor. In their process the cupola is used for the preparation of a synthetic refined iron of a character approaching that employed by Yorkshire and Staffordshire ironmasters for the production of wrought iron of the so-called "Best Yorkshire" brands.

A semi-steel type of mixture of definite analysis is used in the cupola, wherein, by correct slag manipulation, heavy melting losses and lining erosion are counteracted, and the sulphur content of the resulting iron kept low.

The cupola metal is preferably transferred in the molten state to the puddling furnaces, where, by the use of definite proportions of chemically and physically suitable fettling-slags, the complete refining of the puddled material is effected in the minimum time and with very satisfactory iron yield.

The method is already in use, and even where the synthetic refined metal is charged into the puddling furnaces in the solid state the time required for working the charge is from one-half to two-thirds that usually occupied when puddling ordinary forge iron.

In the making of good semi-steel, or, indeed, of any reliably, regular and superior cupola metal for castings, rationally scientific control must be exercised. Similarly, in the making of the Fletcher-Jackson metal and in the puddling of same, control of the mixture analysis and of the slag composition in both cupola and puddling furnace is requisite. As in steel making, good results cannot be obtained by haphazard methods, so it should be emphasised that crude mixtures of steel scrap and pig-irons of variable composition melted in the cupola cannot be made to yield good puddling metal.

The aim of the inventors of the process is to provide a metal which shall have the correct proportion of metalloids present when it is delivered to the puddler. The synthetic refined-iron produced is of such a character that when the carbon therein has been oxidised to about 2 per cent., at which point the plastic or viscous stage of true puddling begins, the metalloids present are in the correct proportions necessary to complete the refining without undue iron waste or the final contamination of sulphur and phosphorus, which is responsible for "red-and-cold shortness" so disastrous to the resulting wrought iron.

Tests made on finished iron rolled from the puddled bars produced by the above-described process have given excellent results, in many cases equal to those made from "Best Yorkshire" iron.

The process is eminently suited to mechanically-operated puddling furnaces whose use in the past has been vitiated by the fact that the wear and tear of the lining of the furnaces, when using crude pig-iron, is excessive.

As in the Fletcher-Jackson metal, most of the impurities are primarily absent, the actual refining work required in the puddling furnace demands but little fettling slag. Hence the wear of the lining and its covering of fettling slag is reduced to the minimum.

If, as is probable, an efficient mechanically-operated puddling furnace will be forthcoming in the near future, then the use in such furnace of the synthetic refined metal should lead to still further economies in fuel and fettling costs and in making the labour of puddling much less arduous and exhausting.

METALLIC MAGNESIUM.—The manufacture in Canada of metallic magnesium was carried on for a few years during the war by the Shawinigan Electro Metals Company, Limited, at Shawinigan Falls, Que., the metal being made from imported magnesium chloride salts.

THE SOCIEDAD ESPANOLA DE CONSTRUCCION NAVAL.—The General Report of the Industries and Commerce of Spain, recently issued by the Department of Overseas Trade, states that this company, which is the premier shipbuilding company in Spain, was started in 1908 with a capital of 20,000,000 pesetas, which has since been increased to 50,000,000. This company operates shipbuilding yards in Ferrol, Cadiz, Cartagena and Bilbao. It has the co-operation of the British firms, Messrs. Vickers, Limited, and Armstrong, Whitworth & Company. It is particularly well placed as regards facilities for construction in Bilbao, where the Sestao Yards are situated quite close to the Altos Hornos, one of the most important shareholders, who supply most of the steel used in construction. This company has orders for the construction of some 100,000 tons of merchant shipping, and in August of this year (1920) the "Alfonso XIII.," a passenger steamer of 14,000 tons, to the order of the Compañía Transatlántica, was launched. This ship, which is the largest launched so far from Spanish yards, is to be completed from stem to stern by the company. A factory has recently been set up at Reinosa for the manufacture of subsidiary material, with a view to making the company entirely self-supporting.

XUM

Steel Castings of Intricate Design.*

By G. Ernest Wells.
Director, Edgar Allen & Company, Limited.

A charge is often made against the British manufacturer that he is always too satisfied with his own productions to be willing to modify his ideas to suit those of the foreign or Colonial consumer. In particular, it has often been stated that certain types of steel castings were not procurable in this country because steel manufacturers here were unwilling or unable to attempt their manufacture, although it is not beyond belief that in the majority of these cases the purchaser was placing his work abroad simply on the question of price.

With the exchanges in their present condition, and with labour and material costs so high in this country, it is impossible in many cases for us to compete against the foreigner where prices are the sole consideration.

One of the great difficulties in the past has been to procure in large quantities, castings, each one of which is an exact replica of the other, in order that machining may be reduced to a minimum, and that such machining as is necessary may be done with the use of jigs.

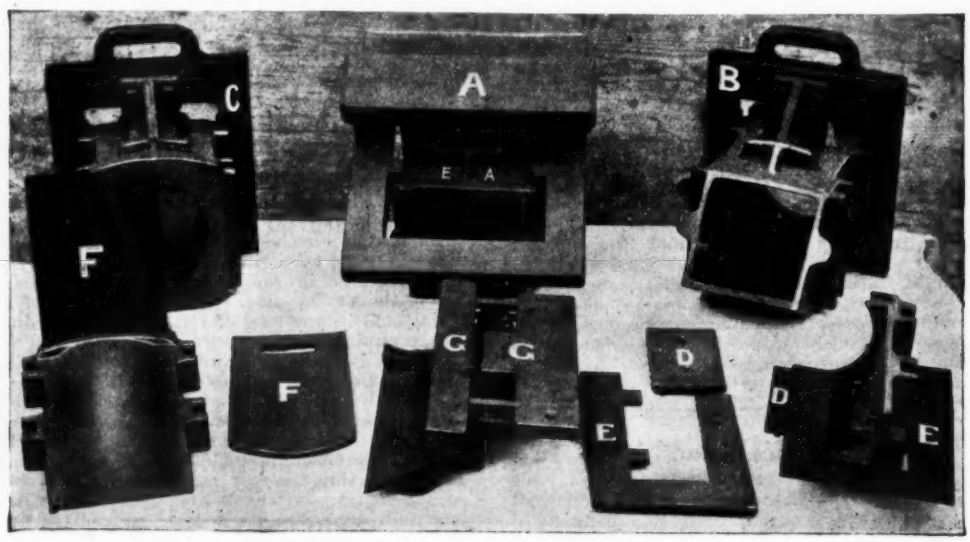


Fig. 1.—An Axle-box Casting together with the Various Gauges used for its Inspection.

During the war many thousands of steel castings for the French and Belgian railways, of a type hitherto not manufactured in this country, were made at the Imperial Steel Works. They were very thin, and required producing accurately to dimension in order to take certain fittings without any machining at all.

The difficulties of manufacture presented by these castings were overcome one after another, and much valuable experience was gained thereby. Subsequently it turned out that the castings had previously been made on the Continent in cast iron, but that with the increasing wagon loads it had been decided to make them in steel, and the same drawings had been used. It was admitted even by the French and Belgian inspectors that their own people had not been asked to produce the same articles in steel, and that under normal conditions, in changing over from cast iron the design would have been modified.

Fig. 1 shows an axle box such as is used in this country, which has been made by Edgar Allen & Company, Limited, to very close limits, in large numbers. Careful examination of the photograph will show a number of gauges used for final inspection, and will give some idea of the care which has been taken in the production of this axle box.

In order better to show the application of the inspector's gauges, an axle box has been cut up in several directions and photographed with the gauges in position; in addition, three complete axle boxes are portrayed.

Gauge A checks the over-all length of the axle box, and also the relative positions of all four guides and the external or spring pad recess. Gauges B and C ensure that the guides are correct throughout their full length, and also that they are in the correct position in regard to the external recess on the top of the box. Gauge F is for the dust shield, and is shown at the left-hand side of the photograph inserted in position; it is, of course, understood that it actually passes completely through the slot from top to the bottom of the box.

Inside the axle box is a seating which receives the bearing, and which must be cast accurately to dimensions, and this is taken care of by gauge D. Fixed in this latter gauge are two pins which communicate with corresponding holes in gauge E, and the latter, when in position, ensures the proper location of the internal seating in respect to the guides on the outside of the box. Gauge G is in two portions, and has the effect of controlling the thickness of the outer shell of the box between the spring pad recess and the bearing seating.

It will be realised that to produce economically and in large numbers steel castings which are required to meet such stringent conditions of inspection, ordinary moulding methods are insufficient. In the present case both the mould and the core are machine-made, and the machines themselves are operated by skilled craftsmen. It is interesting to note that the operatives are given a piece-work price both for the moulds and the cores, and the fact that such excellent finished articles are produced would certainly tend to refute the main objection to payment by results, *i.e.*, that it produces work of poor quality.

* Extracted from the 'Edgar Allen News."

SPANISH SMELTING WORKS.—According to the general report of the industries and commerce of Spain, recently issued by the Department of Overseas Trade, the increased capacity of Spanish blast furnaces is very important. There are now more than 30 at work, and the output of pig-iron and steel is increasing very considerably. The principal manufacturers are:—(1) Altos Hornos de Viscaya, with factories at Baracaldo and Sestao. (2) Sociedad Metalúrgica Duro Felguera. (3) Fabrica de Nueva Montaña, Santander. (4) Fábrica de Micres, Asturias. (5) Cia. Siderúrgica del Mediterráneo, Sagunto. These works produce quantities, practically sufficient for the country's requirements, of both hard grained pig, used by copper mining companies, for the precipitation of copper, and foundry pig. The above firms form a combine, known as the "Central Siderúrgica," which practically controls the output of steel in the country.

Institution of British Foundrymen.

EAST MIDLANDS BRANCH.

First Annual Dinner.

The first annual dinner of the East Midlands branch was held at the Great Central Hotel, Loughborough, on March 19, Mr. H. H. Moore in the chair. Those present included, in addition to the names mentioned below, Messrs. P. A. Bentley (the President of the Leicester Society), A. T. Brotherton (Brush Electrical Engineering Company), J. F. Driver, P. A. Robinson (Leicester Engineers' Federation), J. T. Austen, S. J. Grogan, H. Winterton (Birmingham), V. C. Faulkner (London), H. Bunting (Derby), the Secretary, E. Stevenson, and W. T. Evans.

After the loyal toast given from the chair, PROFESSOR SCHOFIELD, M.B., B.Sc., in giving the toast of "The Institution of British Foundrymen," said his experience on the educational side was somewhat discouraging as regards the younger generation continuing their studies on the foundry department of the Loughborough College, for, speaking frankly, the mental calibre was lamentably poorer than in any other branch of the engineering industry. Yet to reach the top of the industry a foundryman should know a good deal of chemistry, and even more of metallurgy. Their Institute had realised this, and their motto, "Science hand in hand with skilled labour," was full of meaning, and even more essential than science co-operating with the leaders of the industry; but it was the actual workman who needed it more than anything else to continue his studies.

MR. MATT. RIDDELL, acknowledging the honour it was to reply to such a toast, referred to his visit to the Loughborough College. He had read a good deal about it, and he expected something unique. He must, however, speak quite frankly, and he did not think they had a foundry worth much. It seemed to have been placed, as was so often the case with many firms, in any corner, and he did not think they would be able to teach iron founding because there was not the equipment—nothing for measuring air volume and no gauges—there were a great many things lacking before they would be able to carry on teaching. There was still, however, the spirit that survived, in that many were still punching sand, and did not know why they were doing it. What appealed to him more than anything else in the Institution was its educational influences, for the real education came in the foundry. Their Institution adds to the wisdom they got in the foundry by discussing the problems which cropped up. He was dead against spoon-fed education all over the country, for he felt that a great deal of the education was sheer hypocrosy. Education should develop the character, and should make a man better in every sort of way, and interested in life with power to think for himself. Much of the education of bureaucrats was simply cram, and, to his mind, was wasted money and time. It was experience which teaches. Men like Watt, Stephenson, and the like became wise through experience, and they went to book-learning as a valuable thing—it was not, however, the book-learning which made them wise, but it was the wisdom learnt by experience which made them take advantage of every opportunity. The Institution of British Foundrymen is on different lines. We meet voluntarily, and a great many give up other engagements. Last year was a very trying one in their history, but he always had the feeling that the money would be found if they went along on right lines. They were wakening up the men in charge of the foundries, and they began to realise that they wanted the best of men and the best of equipment.

MR. S. H. RUSSELL (Leicester) proposed "Success to the Trade and Commerce of the East Midlands," pointing out the big mineral resources of the district—their coalfields were the only profitable ones at the present time. Trade was certainly very slack just now, and he thought they were pursuing a myth over the German indemnity and the 50 per cent. tax on German goods. The slackness of trade was almost entirely due to the impoverishment of the whole world, and not to over-production, except perhaps in rubber and motor cars. They had to bring prices down to a level so that their old customers could purchase. The cost of labour was 80 per cent. of the total prices on an average, and labour must help them in this matter. He was no advocate of cheap labour, and would be sorry to see wages come down to the level of the past, however much the cost of living came down. He thought they could pay high wages and still cheapen production by labour-saving methods. Trade and commerce depended upon a permanent and lasting peace, and satisfactory relationship between capital and labour.

MAJOR GUEST, M.P. for the Loughborough Division, in reply, dealt on the extraordinary situation created by the war during which time all their energies had been concentrated on destruction. They believed they were right in entering the war and carrying on until it was brought to a satisfactory conclusion, but the effect on trade was very serious and far-reaching. For the first 18 months after the Armistice trade was booming and money was easily made, but it could not last because the power to purchase had been so largely damaged. Now we found ourselves in the difficult period when prices were a secondary consideration to the possibility of finding a purchaser. The first thing they wanted was peace, and until that was established they could not get the channels of trade reopened with communication and transport at anything like the state before the war. They had hardly realised the complex relationships of trade, and now they had the extraordinary variation in the value of the pound, ten times what it was in Germany, twice in France, and with some countries practically ridiculously high. It would not be peace with honour and justice. About that much vexed question of the 50 per cent. he knew it was rash to prophesy, but personally he was inclined to think that Germany will find it difficult to get round that 50 per cent. They had to make up their minds: "Are we going to make Germany pay or not pay?" That was the essential thing as business men, perhaps it might pay them better not to make Germany pay; he could see the argument that way. But was it just? Was that the attitude they should take as a nation with regard to our Allies, taking into consideration the way the French had suffered? This made it almost impossible for us as Allies to let Germany off from paying. The 50 per cent. plan should have a trial; and as 60 per cent. of Germany's exports used to be to Allied countries, if those countries stood together they would force Germany either to pay or lose 50 per cent of her trade. It was a tight screw, but a fair screw for a recalcitrant nation, and he believed in the near future that Germany would come back with very much more sensible proposals than those she brought to London.

The other necessity besides peace for a revival of trade was buyers for our goods. Great masses of population in Europe were incapable of buying anything. Some were weltering under revolutionary conditions which had destroyed their credit. All this had to come right before we could get back our markets as before the war. This seemed almost impossible, yet nothing was so marvellous as the recuperative powers of man. The Balkan States were looking up. Rumania had paid a first instalment on her foreign debt, and he had seen the first cases of goods from Czech-Slovakia.

The difficulty was to bridge over the intervening period, and the duty of the Government was to encourage by every means these countries to recover and help in the regeneration of trade. There had been great discussion over the trade agreement with Russia. The Prime Minister had always believed it essential we should resume trade with Russia. We could not dictate to Russia whether she should be governed in an orderly or disorderly way, but trade with Russia was one of the fundamental essentials of the stabilisation of Europe. It was a tentative agreement, and would probably have very little result in the near future. Still it opened the door, and far from encouraging Bolshevism and revolution he believed it suppressed it. This was trading with the peasants, and would lead, he believed, to a demand for more stable form of government.

XUM

He believed the secret of success in business was co-operation of all the people employed in that business, and until all the partners pulled together business could not prosper. It was natural there should be readjustment and discontent, but if all could come together and decide first of all how to make the industry pay, and then how the profits should be divided. The country which first settled this would go ahead and become the greatest in the world. He had great hopes that England would lead the way in this reorganisation of industry.

Mr. H. L. Reason (President of the Birmingham Branch) gave "The East Midlands Branch," and said they had over 1,800 members now, and at each Council meetings received applications for membership from 40, 50 to 60. The lack of boys and quality was due to the mistakes of our ancestors, but the bad conditions were going and the foundry taking its important part in the industry. They would have to run their foundries so they were an attraction for the boys, and if the craft could be properly explained to the young they would see it contained possibilities absent from the machine shops. They should strive to make the foundry so that a boy could leave the works as clean as from the other departments. The work was of a dirty nature, and more strenuous, and the remuneration must be in accordance with the energy put out, and until these matters are put right they would be all the longer getting the right type of boy into the foundry.

The Institution was particularly proud of this Branch which drew its members from a wide area, and they were extremely fortunate in having firms to help such as Messrs. Herbert Morris's, to whom nothing had been too much trouble.

In response, Mr. Moore said the wide area of the Branch had been of advantage, for they had drawn on exceptional talent, and the lectures given had been one of the factors in their success. Indeed, so educational had been the work that men were now able to criticise the products of the foundry in such a manner that some foremen were getting alarmed.

Mr. H. Pemberton (Vice-President) gave "Kindred Associations," and pointed out how all were working to solve the problems arising in their own departments, and thus formed the lubricant which made the cogs of the whole industry work more easily with regard to the question of amalgamating all the institutions into one huge organisation. He thought the industry would be more efficiently served if all the kindred associations stayed as they were, each one doing the same good work as they were doing to-day.

Lt.-Col. F. Raynor (President of the Northern Society of Engineers) responded, and said if all the engineers were to set themselves the task of reorganising and reviving trade they would be rendering an inestimable service to the country. The foundry represented one of the most vital branches of the industry, and their Institution was playing its part in working for improved conditions.

SCOTTISH BRANCH.

The sixth meeting of the Scottish Branch was held at Glasgow on March 12.

Mr. A. Fraser (Branch-President) occupied the chair, and introduced Dr. A. McCance, who delivered a lecture on the subject of Electric Furnaces.

Electric Furnaces.

The first electric furnace was of very simple construction, and consisted of an open basin to hold the charge with an electrode projecting into its interior. From this simple beginning the electric furnace had passed through many changes in its development.

The lecturer then referred to the construction of the modern electric furnace.

In electric furnace construction strength is the most important factor to be observed, the outer casing should be built of mild steel plate from ¾ in. to 1 in. in thickness. The method of tilting the furnace is also important, the apparatus regulating the tilting of the furnace must be simple and effective. Care should be observed that no heat should escape where the electrodes pass through the roof of the furnace.

The roof frame should be detachable and be in duplicate, so that as little time as possible should be lost when the roof requires re-lining.

The current is supplied to the furnace by means of adjustable electrodes and arcs on to the metal, the circuit being completed through the metal and lining to the neutral conductor connected to the hearth of the furnace.

The mere fact that steel is melted by electricity does not impart any peculiar property or virtue to the material, electricity is simply a means of heating.

The bottom of the furnace is lined with magnesite bricks, and then covered with dolomite mixed with dehydrated tar and rammed into position. The roof of the furnace is lined with silica bricks.

When the furnace has been prepared it is dried by introducing a quantity of coke and switching on the current. After drying, the electrodes are raised, the cokes withdrawn, and the charging is commenced; the charge consists of light steel scrap such as blacksmiths' cuttings or borings. The current is then applied, the electrodes lowered and regulated to give a constant amperage on each phase.

The first charge may consist of from one-half to three-quarters of the total capacity of the furnace, the remainder of the charge is added as the metal melts down.

Before charging is commenced, however, a quantity of lime is placed on the bottom of the furnace; this is necessary to protect the lining against the mechanical and chemical abraiding action arising from rusty scrap.

The length of time required for melting varies through different causes. Much depends on the slagging of the metal. The first slag formed is an oxidising slag, and will reduce the carbon, silicon, phosphorus and manganese content, but it will not reduce the sulphur.

In order to slag the bath sufficiently it is necessary to have the metal at a fairly high temperature. This ensures that the slag will leave the metal readily and preserve the slagging tools.

The next point which requires consideration is that of killing the metal. To achieve this, a second slag is introduced, this slag is deoxidising in its effect. To form this slag, lime fluorspar and a little sand is added, together with definite quantities of anthracite, ferro-silicon and ferro-manganese.

When ideal conditions exist the slag becomes white, which shows that all the iron oxide is removed from the slag, and when the slag is free from metallic oxides so will the steel. Another point is that the slag in its white state becomes a solvent for the sulphur, and, therefore, reduces the sulphur content considerably.

When the condition prevails the only other point to be observed is to bring the metal to its correct pouring temperature. The lecturer stated that quite a number of electric smelting furnaces for the production of pig-iron were now in operation, the iron produced, however, was not suitable for ordinary foundry work.

Sir Robert Hadfield, speaking at the meeting of Hadfields, Limited, held at Sheffield last week, said the hopes that were entertained that the alliance with Harper Bean would afford an outlet for the surplus production of Hadfields' special steels had met with a series of disappointments. He was of the opinion that the present position was entirely attributable to the inability of subscribers for large blocks of shares to take them up and pay for them.

Mr. C. L. Paus, C.B.E., Commercial Secretary to H.M. Legation, Christiania, reporting on the industrial and economic situation of Norway, states in the case of electro-metallurgical industry, the demand for aluminium and refined zinc, which is reported to have been good during the early part of the year, has now fallen off, owing, it is stated, in the case of the former, to depression in the British and American automobile industry, and, in the case of the latter, to over-production. (It is, perhaps, of interest to record that the zinc refineries are said to have used large quantities of German shell fuses as raw material.)

Trade Talk.

THE CONSOLIDATED STEEL CORPORATION are removing their offices on April 25 to 25, Broadway, Cunard Building, New York City.

AN address on "Recent Researches in Steel" was recently delivered to the Birmingham Metallurgical Society by Dr. W. H. Hatfield, of Sheffield.

THE JAPANESE GOVERNMENT will introduce during the present session of the Diet a Bill for the abolition of the import duties levied on shipbuilding materials.

SEVERAL hundred ironworkers, including platers, riveters and caulkers, in Leith shipyards have struck work over a question affecting the employment of apprentices.

THE strike of nut and bolt workers in the Midlands is at an end. A delegate conference was held recently, at which it was decided to resume work on the employers' terms.

BEFORE the members of the Gloucestershire Engineering Society, last week, a lecture on "Process Control" was delivered by Mr. C. A. Hawkins. Mr. J. Macgregor presided.

THE FEDERAL CABINET, Melbourne, Australia, has appointed a board to direct shipbuilding operations, consisting of an expert in ship construction as chairman, an engineer, an accountant, and a naval architect.

THE value of the mineral output of New South Wales last year amounted to £11,411,462, an increase of £1,529,096 over the previous year's figures. The number of men employed in and about the mines was 29,163.

A BILL taxing royalties on iron ore in Minnesota has been passed in the American House of Representatives. The word "royalty" is defined as meaning any fees received by owners of land for the right to explore or mine ore.

THE wages to be paid to the steel millmen at Consett during April, May, and June, 1921, will be 190 per cent. above the standard, or, in other words, 30 per cent below the wages prevailing during the preceding three months.

A VERY interesting and instructive paper on "Metal Cutting Tools" was read before a large number of the foremen and officials of the North-Eastern Marine Engineering Company by Mr. J. W. Eckford, equipment manager.

THE severe depression which is affecting the motor industry of the various countries of Europe and America appears to be less acute in Italy than elsewhere. Up to the present only one Italian motor factory has had to close its doors.

THE CENTRAL COUNCIL FOR ECONOMIC INFORMATION announce that Sir W. G. Armstrong. Whitworth & Company at present have in hand an order for 200 locomotives from the Belgian State Railways, secured in the face of sharp foreign competition.

THE Greek pyrites mines near Kassandra on the Chalcidice Peninsula are again in full swing, and may attain an annual ouput of 200,000 tons. The pyrites are entirely free from arsenic and have a guaranteed sulphur content of between 48 and 51 per cent.

AT this week's quarterly meeting of the London Iron and Steel Exchange an address will be given by Mr. W. T. Layton, director of the National Federation of Iron and Steel Manufacturers, on "Economic Conditions of the Iron and Steel Trades in Europe."

THE net profit realised during 1920 by the Swedish Metal Works Company amounted to Kr. 2,000,000 (£111,111), as compared with Kr. 3,800,000 (£211,111) for the previous year. The directors recommend that the dividend be reduced from 20 to 9 per cent.

MR. JAMES GRAY, general manager of the Monmouth Shipbuilding Company, Limited, at Chepstow, has been appointed managing director. The company propose immediately to lay down the keels of three single screw steam hopper vessels with a carrying capacity of 1,000 tons.

THE wrought hollow-ware employers in the Midlands have ratified the revised schedule of wages provisionally adopted by the joint committee of employers and employed. The schedule is in the nature of a compromise on the original proposals, and will come into operation, if approved by both sides, on May 1.

A POINT of some importance about the recent conferences with the Siemens Steel Association is that the engineers, who include moulders and patternmakers and the members of the Electrical Trade Union, will in future be regarded as engineers and not as men engaged in the steel and tinplate industry.

MESSRS. BOLCKOW, VAUGHAN & COMPANY, LIMITED, the Middlesbrough ironmasters, have concluded arrangements for opening out limestone and iron ore quarries on Hartley Fell, Westmorland. Almost pure limestone is here in immense quantities, and the development of a great industry is anticipated.

WHAT seems to be a promising deposit of lead and vanadium occurs in the Marico district of the Transvaal, on the Doornhoek lead mine Samples analysed by Dr. James Moir, the Government Mining Chemist, indicate a content ranging from 8.15 to 15.5 per cent. of lead metal and from a trace to 1.35 per cent. of vanadium pentoxide.

THE output of the Tayeh iron mines in China in 1919 was 762,804 tons. The bulk of the exports was taken by the Japanese, who control a percentage of the output. The remainder was consumed by the Hanyang Iron and Steel Works, which turned out 186,071 tons of pig-iron, 4,850 tons of steel ingots, and 3,950 tons of other steel products.

IT is announced by the London and North-Western Railway Company that, subject to the approval of the shareholders of each company, and to the necessary legal sanction being obtained, a provisional agreement has been entered into for the acquisition of the Lancashire and Yorkshire Railway by the London and North-Western Railway Company.

ACCORDING to the official statistics of the American Iron and Steel Institute, the production of pig-iron in the United States amounted during the year to December 31 last to 36,925,987 tons, as compared with 31,015,304 tons in 1919, 39,054,644 tons in 1918, 38,621,216 tons in 1917, and 39,434,797 tons, the largest production in the history of the industry, in 1916.

MESSRS. CRAIG, TAYLOR & COMPANY, LIMITED, have launched from their Thornaby Shipbuilding Yard, Stockton on-Tees, the very fine steel screw steamer "City of Tokio," of the following dimensions:—461.3 ft. x 58.10½ ft. x 34.3 ft. to upper deck, 42.5 ft. to bridge deck. She is of the two-deck type, with long poop and combined bridge and topgallant forecastle.

IT is announced that the Fifth Swiss Trade Exhibition will be held at Basle from April 16 to 26 next. This annual event, which has grown out of the historic Fair of Basle dating back to the fifteenth century, is now designed not only to promote the sale of Swiss products at home, but to encourage exports, and with this object in view the directors extend a cordial invitation to British importers.

TO encourage the establishment of the iron and steel industry in British Columbia, the Provincial Government has now entered into a definite agreement with Coast Range Steel, Limited, whereby the Government promises to pay bounties not exceeding $3 per long ton (2,240 lbs.) on pig-iron manufactured from ore mined in the Province, and not exceeding $1.50 on iron made in the Province from foreign ore.

THE IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY announces a further generous donation by a leader in industry, who desires to remain anonymous, to the fund for the provision of scholarships to enable students of the college to spend a year in post-graduate study at American Universities or in works. At present four such students are in America. The present donation will enable four more to be sent for 1921-22.

THE total production of nickel in 1920 in Canada amounted to 30,568 short tons (2,000 lbs.), as against 22,272 in 1919. The production, as usual, represents the nickel in the matte produced from the treatment of the ores of the Sudbury district supplemented by the recovery of a small quantity of metallic nickel, nickel oxides, and other salts, as by-products in the treatment of the silver-cobalt-nickel ores of the Cobalt district.

THE directors and management of the James Keith & Blackman Company, Limited, were entertained by the employés of the company's London works at a complimentary dinner. Some 200 of the London works employes were present, and the whole of the directors and management were invited, but Mr. G Keith, the managing director, owing to the recent death of his father, Mr. J. Keith, was unable to be present. Mr. C. S. Burden presided, and Mr. W. J. Cook was in the vice-chair.

IT is reported that the Quebec Government is considering the question of putting the asbestos mining industry of the Province under control, providing that in the development of the asbestos mines it shall be a condition of the leasing of rights that plants be established in the Province of Quebec for the manufacture or partial manufacture of this material. At the present moment Quebec supplies 85 per cent. of the asbestos requirements of the world, but very little is manufactured in the Province. Over 174,521 tons of asbestos, valued at $11,758,234, were shipped from the Province in 1919-1920.

FOR the meeting of the British Association, at Edinburgh on September 7 to 14, the following presidents of sections have been appointed:—Section A. (Mathematics and Physics), Professor O. W. Richardson; B. (Chemistry), Dr. M. O. Forster; C. (Geology), Dr. J. S. Flett; D. (Zoology), Mr. E. S. Goodrich; E. (Geography), Dr. D. G. Hogarth; F. (Economics), Mr. W. L. Hichens; G. (Engineering), Professor A. H. Gibson; H. (Anthropology), Sir J. Frazer; I. (Physiology), Sir W. Morley Fletcher; J. (Psychology), Professor C. Lloyd Morgan; K. (Botany), Dr. D. H. Scott; L (Education), Sir W. H. Hadow; M. (Agriculture), Mr. C. S. Orwin.

XUM

Personal.

Mr. G. H. Cound has been re-elected president of the Port Talbot (Incorporated) Chamber of Commerce and Shipping.

Mr. John Johnson, 27, Whittall Street, Birmingham, and 402, Victoria Street, Small Heath, file manufacturer, left £5,513.

Mr. Lewis Jenkins, of The Graig, Briton Ferry, merchant, of Messrs. Thomas Jenkins & Son, a former chairman of the Briton Ferry Steel Company, and of the Baglan Bay Tinplate Company, Limited, who died at Bath on November 4 last, aged 70 years, left estate of the gross value of £85,098, with net personalty, £72,310.

Mr. Edwin Parsons, of 4, Queen's Hill, Newport Mon., engineer, who died on January 6 last, left estate of the gross value of £4,896, with net personalty, £3,375.

Mr. F. Z. Lloyd, Stourport, Worcs., chairman of the Swansea Wagon Company, Limited, managing director of the Weldless Steel Tube Company, Limited, left £92,345.

Mr. Rowland Modges, of 14, Highfield Road, Edgbaston, Birmingham, and of Roland Modges, Limited, cabinet brass founders, left £10,459, with net personalty, £6,149.

Mr. Robert Cowan, of Holmcroft, Westoe, South Shields, managing director of Messrs. Brigham & Cowan, Limited, graving dock proprietors and engineers, South Shields, left £75,481. Net personalty, £63,442.

Company News.

Furness Withy, Limited.—Dividend of 6d. per share.

Manganese Bronze & Brass, Limited.—Dividend of 7½ per cent. for year on ordinary.

Metropolitan-Vickers Electrical, Limited.— Dividend on ordinary of 12½ per cent. for past year.

Teneo, Limited.—Capital £100 in £1 shares, to carry on the business of engineers, etc. Registered office: 71, Broadway, Coventry.

Vulcan Foundry, Limited.—Interim dividend of 5 per cent. (1s. per share), less tax, on ordinary, payable April 1.

Guy V. Laycock, Limited.—Capital £10,000 in £1 shares, to carry on the business of engineers. Registered office: 12, Cloth Hall Street, Huddersfield.

Barr Engineers, Limited.—Capital £18,500 in £1 shares (13,000 6 per cent. cumulative preference). Registered office: 89a, Walworth Road, S.E.

Gandy Belt Manufacturing Company, Limited. — Final dividend of 1s. 9d. per share, making 25 per cent., free of tax, on the ordinary shares for the past year.

Hadfields, Limited.—Profit, £107,856; brought forward, £133,610; final ordinary dividend, 6d. per share, making 5 per cent., free of tax; carry forward, £135,727.

Rustproofers (Scotland), Limited. — Capital £10,000 in £1 shares. Private company, to carry on the business of galvanisers, mechanical engineers, founders, contractors, etc.

Steel Company of Canada.—Dividend of 13¼ per cent. on ordinary shares for quarter ending March 31, 1921, payable May 2 to holders of record in Canada April 9, 1921.

Printing Machinery, Limited.—Interim dividend of 7½ per cent. per annum (9d. per share), less tax, on ordinary, for half-year.

Robey & Company, Limited.—Dividend recommended of 2½ per cent. (less tax) on both preference and ordinary; to credit of provident fund for employés, £1,000, carrying forward £27,995.

Steel Developments, Limited.—Dividend proposed at rate of 5 per cent. per annum, free of tax, to directors' remuneration £300, to depreciation of investments £1,000, carrying forward £1,280.

Scottish Tube, Limited. — Net profit, £96,733, and £20,005 was brought in; to depreciation, £4,874; dividend of 5 per cent. and bonus of 1s. per share for year, less tax; carrying forward, £20,341.

Sheffield Steel Products, Limited.—Profits for 1920, £232,528; final dividend proposed of 1s. per share (less tax) on ordinary, making 10 per cent. for year, leaving a balance (subject to taxation) of £171,954.

Vickers, Limited.—The directors of Vickers, Limited, recommend final dividends of 2½ per cent. on the preferred stock and preference shares, making 5 per cent. on each class for the past year.

Barrow Hematite Steel Company, Limited.—Report for 1920 shows gross profits, £388,725. Transferred to special reserve, £150,000. Following dividends recommended:—Full dividend on first and second preference; 5 per cent. on ordinary (subject to tax); non-cumulative dividend on second preference of 2½ per cent. (subject to tax); carried forward, £182,088.

Regan, Bennett & Company, Limited.—Capital £5,000 in 2,000 10 per cent. cumulative preference of £1 and 60,000 ordinary of 1s., to carry on the business of engineers. Registered office: 32, Charing Cross, Whitehall, S.W.

Weldless Steel Tube Company, Limited.—Accounts for 15 months to December 31 show net profit of £24,993, plus £43,505 brought forward, making £68,498. Interim dividends amounting to 15 per cent., free of tax, on ordinary and employé shares have been paid; no further dividend recommended. £10,000 to reserve, £36,652 forward.

Gilbert Gilkes & Company, Limited.—Capital £36,200 in £1 shares, to take over the business of civil, mechanical and electrical engineers carried on at Kendal, and to adopt an agreement with Gilbert Gilkes & Company, Limited. Directors: F. Wilson, E. Crewdson, R. W. Pennington, and W. M. Morris. Registered office: Canal Iron Works, Kendal, Westmorland.

Anderson & Reid, Limited.—Capital £20,000, iron and steel founders, merchants and manufacturers, ironmasters, etc. The first directors are: Mr. J. Anderson and Mr. W. Anderson. 19, Glasgow Street, Ardrossan.

Stewarts & Lloyds, Limited. — Available balance, £568,663. Directors recommend placing £100,000 to reserve fund, £50,000 to income-tax reserve, £10,000 to employés' benefit reserve, and dividends as already announced, carrying forward £114,356.

James Calder & Company, Limited.—Dividend of 15s. per share, free of tax, making 25s. per share for the year. After transferring £2,600 to depreciation and reserve account and £10,000 to special reserve, £771 is carried forward.

Burton, Delingpole & Company, Limited. — Capital £100,000, to acquire and carry on the business of manufacturers of bolts, nuts, screws, and cutlery. Directors: Messrs. J. Burton, W. H. Delingpole, J. T. Tilley, V. E. Young, and W. Willetts. Registered office: 214, Moseley Street, Birmingham.

Gazette.

Messrs. O. Montgomery, A. Turner, and H. Evans, carrying on business at Burnaby Street, Wallasey, under the style of the Press Tool and Metal Stamping Company, have dissolved partnership.

Sheffield Mercantile Steel Company, Limited (late Sheffield Mercantile Supply Company, Limited).—Mr. J. W. Best, St. Peter's Close, Sheffield, chartered accountant, appointed receiver, March 11.

Messrs. F. F. Adamson and R. S. McLean, trading under the style of Adamson & McLean, 1, Queen's Crescent, and 12, Tintern Street, Sunderland, engineers, have dissolved partnership. Mr. F. F. Adamson will continue the business under the style of Fred. F. Adamson.

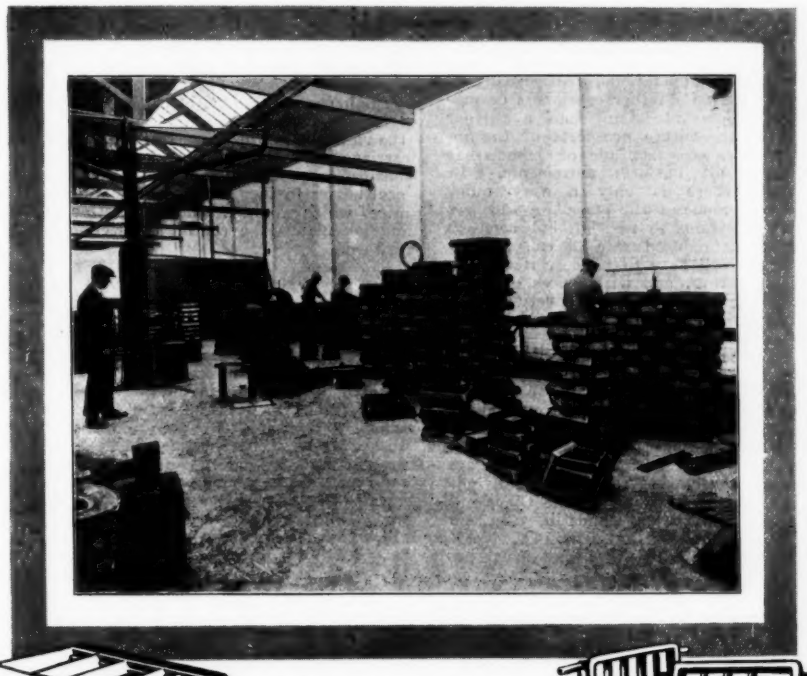
Walter William Holton, 98, Lee Bank Road, Birmingham, brassfounder and director of a limited company, late trading at 21, Milk Street, Birmingham. First meeting of creditors, 191, Corporation Street, Birmingham, April 8, at 11.30. Examination, C.C. Birmingham, April 27, at 2.30.

Sheffield High Speed Tool Manufacturing Company, Limited.—Resolved March 14:—That the company be wound up voluntarily. Mr. W. H. Wheatcroft, Jno. Watson & Sons, 11, Leopold Street, Sheffield, chartered accountant, liquidator. Claims to liquidator by April 30.

The partnership heretofore subsisting between Alf. Noblett Wilkinson, and Jas. Lewis, trading as Lewis & Wilkinson, 196, Attercliffe Road, Sheffield, general ironfounders, has been dissolved. Debts by A. N. Wilkinson, who continues the business as A. N. Wilkinson & Company.

In the Chancery Division Mr. Justice Astbury again had before him the petitions of the Compania Naviera Mundaca Sociedad Anonima and Sir W. G. Armstrong, Whitworth & Company, Limited, for the compulsory winding up of the Gardiner Shipbuilding and Engineering Company, Limited. It was agreed that the petition should stand over until April 12.

THERMONITE. — We have received from Messrs. J. H. Sankey & Son, Limited, of Essex Wharf, Canning Town, London, E.16, a small crucible made of Thermonite. They state that this material will resist oxy-coal gas flame (2,200 deg. C.) indefinitely, and for short periods the oxy-acetylene and electric arc flame. Amongst its chief uses are the facing of the interior of furnaces, backed by refractory materials of lower grade, and the general replacement of the highest quality of firebricks.



CORRUGATED
PRESSED STEEL FOUNDRY FLASKS.

Made to any Size and Specification.

Designs submitted against Customers' Patterns or Drawings.

THOUSANDS IN DAILY USE.

LIGHT, RIGID, UNBREAKABLE,
and
FULLY GUARANTEED.

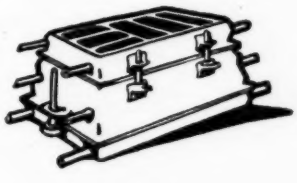
Write for Stock List and Prices.

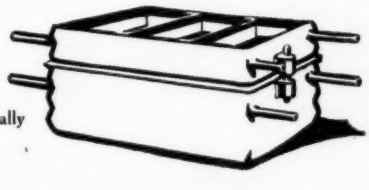
PERFORATED REINFORCED PRESSED STEEL
CORE PLATES.

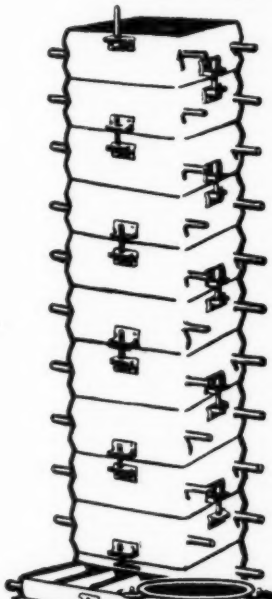
SHEET METAL WORK
of all Descriptions.
Black and Galvanised.

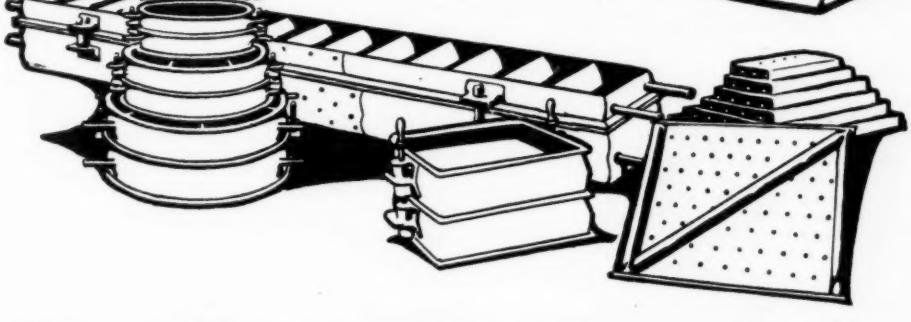
HIGH-CLASS WORK
for Engineers a Speciality.

Rivetted, Oxy-Acetylene or Electrically Welded









SHEET METAL & GALVANIZING CO., LTD.

Spencer Road, Lidget Green, Bradford.

IRON AND STEEL MARKETS.

Pig-Iron.

Reviewing the position of the pig-iron trade at the close of the first quarter's operations, it can hardly be described as encouraging for either consumers or producers, recent developments having had a further depressing effect on the future prospects of the industry, while the menacing attitude of labour has temporarily checked all business movements. In South Staffordshire there is only a very quiet inquiry for pig-iron. Some of the output of furnaces now damped down remains to be sold, but smelters hold that even at the reduced rate of consumption foundries and forges will have to increase their purchases in the near future, and with prices down to a level which again gives the home producer a good fighting chance against the Continental invader, it is hoped that the outlook may improve. The recent reductions in coke have eased matters, but much greater relief is necessary in both coke and other materials, as well as wages. In Scotland conditions remain unchanged. Even the reduced output cannot be absorbed by current requirements, and in consequence the smallest order is acceptable. The consumers continue their policy of hand-to-mouth buying, those who come into the market covering usually not more than a week's supply of iron. In the Cleveland pig-iron trade business is at a standstill. Current quotations are: No. 1, 150s., No. 3 G.M.B. 149s., No. 4 foundry 147s. 6d., No. 4 forge 145s. to home consumers, and 5s. more for export in each case.

Ore.

With production of pig-iron decreasing in all directions the trade in foreign ore has almost reached the vanishing point, most of the chief smelting interests having heavy stocks on hand, without any immediate prospect of requiring renewal. Shipments from Spanish ports are consequently curtailed, and with buying completely at a standstill the price of best rubio ore is purely nominal at 37s. 6d., ex-ship Tees, for 50 per cent. quality. There is nothing doing in native ore.

Scrap.

Stagnation continues unabated in the scrap trade in all the chief centres where this form of material is consumed, the position being further complicated by numerous offers from abroad at almost ridiculously low prices. It is now exceedingly difficult to dispose of the best quality of scrap metal at even "giving away" quotations, so many consumers having already overstocked or over-bought on forward account, that business is practically impossible in the existing conditions.

Furnace Coke.

Notwithstanding recent reductions in fuel prices, coke continues at levels much too high for the majority of foundry and furnace consumers, who are consequently confining their buying to hand-to-mouth dealings. On Tees-side good medium furnace qualities of coke are now obtainable round about 42s. 6d. per ton, but the market is exceedingly slow and little actual business is possible.

Finished Iron.

The decision of the miners' unions to call an immediate strike has had the effect anticipated, few works having restarted; some of them not even knowing where to look for orders to set to work upon. Makers of best bars experience a better demand than other branches of the trade. The marked falling-off of inquiries for iron strip this year is forcing a re-examination of the position. For the time the quotation remains unchanged, but is more than consumers will pay with steel strip coming in from the Continent at about half the price.

Steel.

Most of the works having closed down for an extended period for the Easter holidays, movements in the steel industry have been without any outstanding features of interest, and, so far, there has been no lightening of the air of depression which overshadows trade prospects in general. Indeed, the latest developments of the miners' demands have completely paralysed business in every direction, and with the lamentable prospect of a prolonged struggle the stagnation already existing in the steel industry is further accentuated. In the meantime, steel price-cutting continues in certain sections, the latest reported applying in the case of steel hoops, which have been further reduced £3. The quotation now ruling in Sheffield is £20 5s., as compared with £39 in October last. In steel trade circles the impression prevails that prices must shortly reach much lower levels, but, of course, a return to pre-war figures is virtually impracticable when regarded from the view point of heavy increases in wages, fuel, railway carriage, carting costs, postage, and all kinds of maintenance expenses, but it may be possible to get a good deal nearer to them. Some makers are disposed to fix prices which would be unremunerative at the moment, and speculate on a continuous decline of costs henceforward.

Tinplates.

For very obvious reasons, business in the tinplate market this week has been on the usual subdued scale, recent inquiries from abroad, previously noted, having, so far, failed to materialise in the concrete form of orders. Transactions were mainly confined to stock parcels, which changed hands at round 25s. to 25s. 6d. basis for coke finish, net cash, f.o.t. at works. For April, May, June, 28s. to 28s. 6d. is generally quoted, but very little actual business is reported, buyers only covering their immediate requirements, which are not large. Wasters are in quiet request, 18s. 6d. to 19s. being paid for C.W. 14 by 20; 38s. to 38s. 6d. for C.W. 28 by 20; and C.W. 14 by 18¼ have improved to 14s. 6d. to 15s., all net, f.o.t. Terneplates are in very poor demand, 27s. 6d. is quoted for the usual finish, without finding buyers.

Metals.

Copper.—Influenced by the crisis in the labour world the week's markets for standard copper opened under depressing conditions, and though nothing like panic symptoms developed the tone throughout was disappointing, if not actually stagnant. The demand for consumption was again on a declining scale, while prices have receded to pre-war levels. The tendency in forward metal was also in the direction of restricted sales, May being done at £66, June at £68 to £67 15s., and three months at the last-named figure. Closing prices:—Cash: Wednesday, £70 12s. 6d.; Thursday, £70; Friday, £70 12s. 6d.; Monday, £69; Tuesday, £68 7s. 6d. Three Months: Wednesday, £70; Thursday, £69; Friday, £70; Monday, £68; Tuesday, £68.

Tin.—Weaker conditions reported in cables from the East, giving sales at Penang at £164 c.i.f., were reflected in markets on this side at the opening, and prices declined to lower levels. Subsequently offerings came more freely, and with the possibility of extensions of the strike movement values further weakened for both cash and forward metal, closing 65s. and 72s. 6d. lower respectively in each case. English ingots also closed 70s. lower at £150. The weekly return of tin stocks in London warehouses show a decrease of 107 tons at 4,549 tons. Closing prices:—Cash: Wednesday, £159 10s.; Thursday, £158 10s.; Friday, £157 5s.; Monday, £154; Tuesday, £152 10s. Three Months: Wednesday, £162 15s.; Thursday, £162; Friday, £160 15s.; Monday, £157; Tuesday, £156 5s.

Messrs. Rudolf Wolff & Company's review for last week upon the tin position embodies some highly-instructive summaries which have been received from their own correspondents at the chief centres of production and consumption. It is interesting to learn, for instance, that as the result of "pegging" the price for a few months in order to enable the mines to carry on in face of the slump in the metal the Federated Malay States Government has accumulated 10,000 tons, which, it is stated, will not be sold at a loss. It is none the less a point to bear in mind in considering the prospects of a trade demand raising the price of the metal to a commercial level that this large quantity of tin will be coming upon the market as soon as it can be realised at a moderate profit.

Spelter.—After showing some improvement, owing to freer purchases by galvanisers last week, spelter has relapsed to quieter conditions, and an easier tendency in values has developed. The fluctuation in a downward direction has not, however, been more than fractional, and with selling restricted, near and forward dates metal closed 5s. lower. April sold at £24, and June at £25. English nominal £27 10s.

Lead.—The market for lead continues quiet, consumers' demand having been limited, and dealings mostly professional. Arrivals from the Continent are again heavy. Soft foreign prompt closed £19 7s. 6d., with English 10s. lower at £20 15s.

BRITISH STEEL FOUNDERS!

THE WAR SHOWED YOUR
ABSOLUTE DEPENDENCE ON
FOREIGN SANDS

☛ THE SAME WAR SET YOU FREE

and provided you with an All-British Sand freely admitted by British and even some Belgian Steel Founders to be better in every way than any imported Sand, and known the country over as

"YORKSHIRE SAND"

which strips cleaner, needs less nails, carries greater weights, is more regular, stands more mixing sand than any French or Belgian Sand on the market, and is

CHEAPER IN EVERY WAY.

Why return to the Foreign Yoke?
Why create more unemployment at home?
Why send British money out of the country?

THE GENERAL REFRACTORIES Co., Ltd.
KELHAM ISLAND, SHEFFIELD,

Telephone: 3577 (2 lines) *Telegrams: Refractory, Sheffield*

WILL BE PLEASED TO DEMONSTRATE TO YOU

(1) *The Best way to use "Yorkshire Sand."*
(2) *That it is cheaper than any Foreign Sand.*
(3) *That it is better in every single respect.*

YORKSHIRE SAND IS SUPPLIED IN 4 GRADES.

"EXTRA STRONG" as a binder for Silica Sands which we can supply cheaper and better than anyone else.

"STRONG" for large work, and to be let down for medium and small castings.

"ORDINARY" for medium stoved work, and may be let down for small castings if desired.

"GREENSAND" ready for use for Skin-dried, Greensand and Light Stoved Work.

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	68/7/6—68/10/0
Three months	68/0/0—68/2/6
Electrolytic	72 10 0
Tough	69 0 0
Best selected	69 0 0
Sheets	116 0 0
India	116 0 0
Wire bars	72 0 0
Do. May	72 0 0
Do. June	72 0 0
Ingot bars	71 10 0
H.C. wire rods	80 10 0
Off. aver. cash, Mar.	67 13 3⅜
Do. 3 mths., Mar.	67 7 0⅜
Do. Settlement Mar.	67 12 8⅜
Do. Electro Mar.	71 15 0
Do. B.S., Mar.	69 18 10⅜
Aver. spot, copper Mar.	67 12 7½
Do. Electro, Mar.	72 6 2½
Solid drawn tubes	15½d.
Brazed tubes	15½d.
Wire	12d.
Yellow metal rods	9d.
Do. 4x4 Squares	11d.
Do. 4x3 Sheets	11d.

BRASS.

Solid drawn tubes	13⅜d.
Brazed tubes	16⅜d
Rods	12⅜d.
Sheets to 10 w.g.	12⅛d.
Wire	12⅛d.
Rolled metal	11⅛d.

TIN.

Standard cash	152/10—152/15
Three Months	156/5—156/10
English	150 0 0
Bars	152 0 0
Chinese	147 0 0
Straits	163 0 0
Australian	160 0 0
Eastern	166 0 0
Banca	169 0 0
Off. aver., cash, Mar.	156 4 7
Do. 3 mths., Mar.	159 13 1½
Do. Sttlment., Mar.	156 2 1½
Aver. spot, Mar.	156 0 3

SPELTER.

Ordinary	24 0 0
Remelted	21 5 0
Hard	19 0 0
Electro 99.9	32 10 0
English	27 10 0
India	22 0 0
Prime Western	24 15 0
Zinc dust	55 0 0
Zinc ashes	6 0 0
Off. aver., Mar.	25 10 5
Aver., spot, Mar.	25 1 6½

LEAD.

Soft foreign ppt	19 7 6
English	20 15 0
Off. average, Mar.	19 2 9½
Average spot, Mar.	18 18 2½

ZINC SHEETS.

Zinc sheets, spot	36 0 0
Do. V.M. ex. whf	37 0 0
Do. ppt., f.o.b., N.Y.	—
Dutch	35 0 0
Boiler plates	33 0 0
Battery plates	32 10 0

ANTIMONY.

English regulus	37 5 0
Special brands	42 0 0
Chinese	23 10 0
Crude	19 0 0

QUICKSILVER.

Quicksilver	12 10 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
45/50%	17 10 0
75%	25 0 0
Ferro-vanadium—	
35/40%	25/- lb. va.
Ferro-molybdenum—	
70/80%	10/6 lb. mo.
Ferro-titanium—	
23/25%, carbonless	1/6 lb.
Ferro-phosphorus, 20/23%	£32
Ferro-tungsten—	
80/85%, carbon free	1/10 lb.
Tungsten metal powder—	
98/99%	2/3 lb.
Ferro-chrome—	
4/6% car.	£37 10
6/8% car.	£37
8/10% car.	£36 0
Ferro-chrome—	
Max. 2% car.	£84
Max. 1% car.	£100
Max. 0.75% car.	£115
65/75%, carbonless	2/10 lb.
Nickel—99·8%, cubes or pellets	£200
Cobalt metal—97%.	19/0 lb.
Aluminium—98/99%	£150
Metallic Chromium—	
98/99%	6/6 lb.
Ferro-manganese—	
76/80%, loose	£20—£25
76/80%, packed	£21—£26
76/80%, export	£20—£22 10
Metallic manganese—	
98/99%, carbonless	3/1 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s. d.
Finished bars, 14% tungsten	3 0
Finished bars, 18% tungsten	3 9
Scrap pieces	5d.
Turnings and swarf	3d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares 3 in. to 8 in. inclusive 4d. lb.

Rounds and squares under ½ in. to ¼ in. 3d. lb.

Flats under 1 in. by ⅜ in. to ½ in. by ¼ in., and all sizes over four times in width over thickness 3d. lb.

Bevels of approved sizes and sections 6d. lb.

If in coils 3d. lb.

Packing 4s. cwt

Bars cut to length 10% extra

Scrap from high-speed tool steel—

Scrap pieces 5d.

Turnings and swarf 3d.

Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—£ s. d.	£ s. d.
Heavy Steel	4 0 0
Bundled steel & shearings	4 0 0
Mixed iron & steel	4 10 0
Heavy cast iron	4 15 0
Good machinery for foundries	7 10 0
Cleveland—	
Heavy steel	3 5 0
Steel turnings	3 0 0
Cast-iron borings	3 0 0
Heavy wrought iron piling	5 15 0
Bundling scrap	5 5 0
Cast-iron scrap	7 5 0
Lancashire—	
Cast iron scrap	7 0 0
Heavy wrought	4 10 0
Steel turnings	2 10 0
London—	
Copper (clean)	53 0 0
Brass (clean)	30 0 0
Lead (less usual draft)	15 0 0
Tea lead	12 0 0
Zinc	12 0 0
New aluminium cuttings	70 0 0
Braziery copper	43 0 0
Gun metal	48 0 0
Hollow pewter	110 0 0
Shaped black pewter	65 0 0

PIG-IRON.

N.-E. Coast—	
Foundry No. 1	155/-
Foundry No. 3	150/-
Forge No. 4	147/6
Mottled	147/6
Hematite No. 1	182/6
Hematite M/Nos.	180/-
Midlands—	
Staffs. common	145/-
,, part-mine forge	160/-
,, ,, foundry	170/-
,, Cold blast	350/-
,, basic	140/-
Northants forge	140/-
,, foundry No. 3	160/-
,, basic	140/-
Derbyshire forge	160/-
,, foundry No. 3	170/-
,, basic	160/-
Scotland—	
Foundry No. 1	172 6
,, No. 3	167 6
Hematite M/Nos.	180/-
Sheffield (d/d district)—	
Derby forge	165/-
,, foundry No. 3	170/-
,, basic	165/-
Lincs. forge	165/-
,, foundry No. 3	170/-
,, basic	162/6
E.C. hematite	193/-
W.C. hematite	196/-

All d/d in the district.

Lancashire (d/d eq. Man.)—	
Derby forge	—
,, foundry No. 3	180/-
Northants foundry No. 3	—
Cleveland foundry No. 3	—
Staffs. foundry No. 3	—
Lincs. forge	172/6
,, foundry No. 3	177/6
Summerlee foundry	195/6
Glengarnock foundry	195/6
Gartsherrie foundry	195/6
Monkland foundry	195/6

FINISHED IRON & STEEL.

Iron—	£ s.	£ s. d.
Bars (cro'n)	20 0	24 10 0
Angles	20 10	25 0 0
Tees to 3 united ins.	21 0	25 10 0
Nut and bolt		22 0 0
Hoops		23 0 0
Marked bars (Staffs.)		27 10 0
Gas strip		26 0 0
Bolts and nuts, ¾ in. × 4 in.		42 0 0
Steel—		
Ship plates		19 0 0
Boiler plates		25 0 0
Checquer plates		22 0 0
Angles		17 10 0
Tees		18 10 0
Channels		18 0 0
Joists		17 10 0
Rounds, ⅞ in.–3-in.		17 0 0
Rounds, 3 in.–5½ in.		16 0 0
Flats, 5 in.–8 in.		16 10 0
Flats over 8 in.		16 0 0
Rails, heavy		18 0 0
Fishplates		23 0 0
Hoops		18 10 0
Black sheets, 24 g.		23 0 0
Galv. cor. sheets, 24 g.		24 0 0
Galv. fencing wire, 8 g. plain		30 0 0
Rivets, ¾ in. dia		30 0 0
Billets, soft		13 10 0
Billets, hard		14 10 0
Sheet and tin bars		14 10 0

PHOSPHOR BRONZE.

Rolled.	Per lb. s. d.
½ in. to 1 in. wide	1 11½
1 in. to 1½ in. wide	1 10½
1½ in. to 2 in. wide	1 9½

Strips.	s. d
2 in. to 6 in. to 26 S.W.G.	1 8½
6 in. to 12 in. to 26 S.W.G.	1 8½

Sheets.	s. d
12 in. to 18 in. to 24 S.W.G.	1 9
18 in. to 24 in. to 24 S.W.G.	1 9½
24 in. to 30 in. to 20 S.W.G.	1 10½
30 in. to 36 in. to 16 S.W.G.	1 11½
36 in. to 42 in. to 16 S.W.G.	2 0½

Extras.

For Gauge: Any width up to 36 in. wide, ½d. per lb. per thinner gauge.

Drawn Rods.	s. d
¼ in. to ⅝ in. dia. in random lengths	1 9½
⅝ in. to 1½ in. dia. in random lengths	1 9½
Over 1½ in. to 1⅝ in.	1 9½
Tubes—basis price	1 11½

Delivery 2 cwt. free to any town.

10% phosphor copper, £40 above price of B.S.

15% phosphor copper, £50 above price of B.S.

Phosphor tin (5%), £30 above price of English ingots.

Charles Clifford & Son, Limited, Birmingham.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	1/3 to 1/9
Rolled—	
To 9 in. wide	1/10½ to 2/4½
To 12 in. wide	1/11 to 2/5
To 15 in. wide	2/– to 2/6
To 18 in. wide	2/1 to 2/7
To 21 in. wide	2/2 to 2/8
To 24 in. wide	2/3 to 2/9
Ingots for spoons and forks	1/3 to 1/9
Ingots rolled to spoon size	1/6 to 2/–
Wire round—	
3/0 to 10. G.	2/1 to 2/8

with extras according to gauge

AMERICAN IRON & STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	27.84
No. 2 foundry Valley	26.00
No. 2 foundry, Birm.	25.00
Basic	26.96
Bessemer	28.96
Malleable	26.00
Grey forge	26.96
Ferro-manganese 80 % delievred	90.00
Bess. rails, h'y, at mill	45.00
O.-h. rails, h'y, at mill	47.00
Bess. billets	38.50
O.-h. billets	38.50
O.-h. sheet bars	40.00
Wire rods	52.00
	Cents.
Iron bars, Phila.	2.70
Steel bars	2.00
Tank plates	1.90–2.10
Beams, etc.	2.10
Skelp, grooved steel	2.35
Skelp, sheared steel	2.50
Steel hoops	2.80
Sheets, black, No. 28	3.85
Sheets, galv., No. 28	5.00
Sheets, blue an'l'd, 9&10	3.00
Wire nails	3.00
Plain wire	3.00
Barbed wire, galv.	3.85
Tinplate, 100-lb. box	$7.00

COKE.

Welsh foundry	72/6
,, furnace	57/6
Durham & North. foundry	70/-
,, furnace	42/6
Other Districts, foundry	77/9
,, furnace	45/-

SWEDISH IRON.

Bars, hammered basis sizes ..	Basis price. £ s. d. 31 0 0 to 38 0 0
Rolled Ordinary—Assortment ..	
Nail Rods—Square, round and flats ..	
Keg Steel) about Faggot Steel) £50	Prices nominal.
Blooms—Single welded ..	£20 to £25
Billets—Single and double welded ..	£22 to £27
Pig-Iron—Grey, white or mottled ..	£15 to £20

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents there.

TUBES.

	Up to and incl. 2 in.	Over 2 in.
Gas ..	−10%	−15%
Water ..	net	−6¼%
Steam ..	+11¼%	+3¾%

TINPLATES.

I.C. Cokes,	20×14, box	25/-
,,	28×20, ,,	53/-
,,	20×10, ,,	37/-
,,	18⅞×14, ,,	30/-
I.X.	,,	73/-
I.X.X.	,,	103-
F.C.B.Y.	21×13⅝ ,,	50/6
C.V.B.G.	16½×15, ,,	50/-
I.C.W.	20×14, ,,	18/6
,,	28×20, ,,	38/-
,,	20×10, ,,	28/-
,,	18⅞×14, ,,	14/9
Terneplates,	28×20, ,,	55/-

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
Mar.30	70	12	6	inc.	20/-
,, 31	70	0	0	dec.	12/6
Apr. 1	69	0	0	dec.	20/-
,, 4	68	0	0	dec.	20/-
,, 5	68	7	6	inc.	7/6

Electrolytic Copper (Cash).

Mar.30	72	10	0	No change
,, 31	72	10	0	No change
Apr, 1	72	10	0	No change
,, 4	72	10	0	No change
,, 5	72	10	0	No change

Standard Tin (cash).

Mar.30	159	10	0	dec.	40/-
,, 31	158	10	0	,,	20/-
Apr. 1	157	5	0	,,	25/-
,, 4	154	0	0	,,	65/-
,, 5	152	10	0	,,	30/-

Tin (English Ingots)

Mar.30	156	0	0	No change
Mar.31	156	0	0	No change
Apr. 1	154	0	0	dec. 40/-
,, 4	150	0	0	dec. 80/-
,, 5	149	0	0	dec. 20/-

Zinc Sheets (spot).

Mar 30	36	0	0	No change
,, 31	36	0	0	No change
Apr. 1	36	0	0	No change
,, 4	36	0	0	No change
,, 5	36	0	0	No change

Spelter (ordinary).

Mar.30	24	5	0	dec.	20/-
,, 31	24	5	0	No change	
Apr. 1	24	5	0	No change	
,, 4	24	0	0	dec.	5/-
,, 5	24	0	0	No change	

Lead (English).

Mar.30	21	10	0	No change	
,, 31	21	5	0	dec.	5/-
Apr. 1	21	5	0	No change	
,, 4	20	15	0	dec.	10/-
,, 5	20	15	0	No change	

SHROPSHIRE IRON Co., Ltd.

Works —
Hadley, Shropshire.

Telegrams :—
Sun, Wellington, Salop.
Sunbrand (Cannon), London.

London: 10, Bush Lane, Cannon St., E.C.4.

Telephone :—
11 Wellington, Salop.
5959 Central.

BARS, HOOPS, SECTIONS & WIRE
in IRON, STEEL, COPPER and BRONZE.

Galvanised Telegraph, Telephone, Cable and Trolley Wire
To all Specifications.

Contractors to H.M. Government (Admiralty, G.P.O., India Office, War Office, Colonies), English and Foreign Railways, &c.

BEST H. C. COPPER & BRONZE WIRE a speciality.

Medals:—Sydney (Bronze) 1879, New Zealand (Gold) 1882, Liverpool (Silver) 1886, Adelaide (Gold) 1887, Franco-British Grand Prix (Highest Award) 1908.

ROBERT HEATH & LOW MOOR, LIMITED,
Stoke-on-Trent.

d.B.H. IRON.
At works.
BARS, ANGLES, TEES and PLATES.

R.H. ♔ IRON.
Delivered F.O.B. Liverpool.
BARS, ANGLES, TEES and PLATES.

HOOPS delivered F.O.B. Liverpool.

IRON
R.D. ♔
RAVENSDALE (Best)

MILD STEEL (up to 2in. wide)
Marked
"HEATH'S SOFT STEEL."

Prices on Application.

WILLIAM JACKS & COMPANY,
5, EAST INDIA AVENUE, LONDON, E.C.3.

Telegrams: ALKALIZE, BIRMINGHAM.
Telephone: CENTRAL 1175 & 1176
Birmingham Office:
18, BENNETT'S HILL.

Telegrams: ALKALIZE, LONDON.
Telephone: 7860 AVENUE (3 lines.
Head Office:
5, EAST INDIA AVENUE, London, E.C.

REGISTERED TRADE MARK

PIG IRON.

Scotch, Middlesbro,' Hematite, Basic, Specials, &c., &c.

TIN — SPELTER — CHROME
COPPER — ANTIMONY—MANGANESE.

WILLIAM COLVIN & COMPANY,

ROYAL EXCHANGE, MIDDLESBROUGH.

93, HOPE STREET, GLASGOW.

SITUATIONS VACANT AND WANTED.

JOURNEYMAN MOULDER, at present disengaged, desires post; Midlands preferred.—Box 720, Offices of the Foundry Trade Journal, Bessemer House, 5, Duke Street, Adelphi, Strand, London, W.C.2.

FOREMAN PATTERNMAKER (40), desires re-engagement; good organiser and controller. Exp. Motor, Marine, Cent. Pumps, and Loam.—Box 722, Offices of the Foundry Trade Journal, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

WANTED.—Foundry Foreman, possessing thorough knowledge all types Moulding Machines, as well as good General Foundry Experience, for Midlands.—Apply in writing, Geo. C. Usher, Coventry House, South Place, London, E.C.

MACHINERY.

"FARWELL" HAND-SQUEEZE MACHINE Wanted.—Write, giving full particulars, to Box 724, Offices of the Foundry Trade Journal, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

MARINE BOILERS.—
FOR SALE Single-ended BOILERS, 13 ft. by 11 ft. 3 in.
Three corrugated furnaces, Deighton type.
Howden's forced draught.
Working pressure 200 lbs.
First-class condition as practically new, and Lloyds will accept as new from instalment.
Apply, Robinson Brown & Company, Newcastle-on-Tyne

NEW FLETCHER, RUSSELL Melting Furnace (forced draught or high-pressure gas) 400 lbs. cap. tilting type; all latest improvements; complete with crucible, etc.; cost about £200. What offers? No reasonable offer refused.—The Furnace Exchange, Croft Street Engineering Works, Preston, Lancs.

WANTED, SECOND-HAND EMERGENCY CUPOLA.—State price and particulars to The Atlas Mechanical Company, Limited, 10a, Old Town, Clapham, London, S.W.4.

FOR SALE.

TWENTY-FOUR MARINE TYPE SELF-CONTAINED WATER TUBE BOILERS, by Messrs. Babcock & Wilcox, Limited, varying in heating surface from approximately 1,610 to 2,813 square feet per boiler, constructed for a working pressure of 270 lbs. per square inch.

ONE LANCASHIRE BOILER, 30 ft. × 8 ft. dia., reinsure 120 lbs. pressure.

TWO CORNISH BOILERS, 28 ft. × 6 ft. dia., reinsure 90 lbs. pressure.

TWO MARINE BOILERS, 10 ft. 4 in. long × 12 ft 2 in. dia., reinsure 150 lbs. pressure.

ONE VERTICAL BOILER, 6 ft. × 3 ft. dia., reinsure 80 lbs. pressure.

ONE VERTICAL BOILER, 6 ft. 6in. × 3 ft. 9 in. dia., reinsure 80 lbs. pressure

ONE LOCO TYPE BOILER, barrel 12 ft. long × 4 ft. 8 in. dia., reinsure 160 lbs. pressure.

ONE OPEN TOP RIVETED CISTERN, 8 ft. 6 in. × 7 ft. 6 in. × 5 ft. 10½ in. deep at one end, and 5 ft. 4 in. deep at other end (average, 5 ft. 7 in. deep).

SEVERAL UNUSED SECTIONAL STEEL CISTERNS, 8 ft. × 8 ft. × 4 ft. deep, capacity about 1,600 gallons each.

SEVERAL DISHENDED CYLINDERS, each 6 ft. × 2 ft., tested hydraulically to 150 lbs. pressure

ABOUT 4,300 ft. run of Galvanised Piping, 2 in. diameter.

ABOUT 1,300 ft. run of New Cast-iron Piping, 6 in diameter.

LARGE NUMBER OF GALVANISED STEEL WIRE ROPES, each 300 ft. long × 1¼ in. circumference, thimble at one end.

CATALOGUE OF STOCK MACHINERY, 5-6,000 LOTS, FREE ON APPLICATION. INSPECTION INVITED.

THOS. W. WARD, Ltd.,
ALBION WORKS, SHEFFIELD.
Telegrams: "Forward, Sheffield."
Telephone: 4321 (8 lines).

MISCELLANEOUS.

FOUNDRY FOR SALE.—Upset price £4,000. Good reasons for sale. Present Proprietor could leave some capital at reasonable int. or share with suitable party.—Apply, Box 726, Offices of the Foundry Trade Journal, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

ORDERS WANTED for small Machine-made Castings in Brass, Gunmetal, Phosphor, or Manganese Bronze. Also Castings any size up to one ton in weight. Prompt delivery.—James G. Crowther, Paradise Street Brass Foundry, Sheffield.

WANTED to Purchase, Surplus Stocks of Valve Stampings in the following steel specifications: K.8, K.9, S.19, and 3 per cent. nickel.—State size, price and quantity to Box. 714, Offices of the Foundry Trade Journal, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

40,000 HIGH GRADE STEEL BLANKS: 3 in dia. × ⅞ in. thick × ⅜ in. hole; 3⅞ in dia. × ⅜ in. thick × ⅜ in. hole; 4½ in. dia. × ⅜ in. thick × ⅜ in. hole. Price 20s. per cwt. Samples free.—B.E. Co., 304, High Holborn, London, W.C.

FOR SALE, cheap, Foundry Pig Iron, all sections, F.B. Steel Rails, with all accessories; Joists, Channels, Angles, Sheets and Plates, all thicknesses; plumbago.—Ascoc, Golder's Green, London. Telephone; Hampstead, 1806.

WE Specialise in FANS and FAN WORK for Foundries. H.P. Fans and Blowers for Smiths' Hearths, Cupolas, Oil and Gas-fired Furnaces, Dust Extraction Fans for Fettling Shop and Sand Blast, Ventilating Fans for Fumes, etc. Worm-geared Pulley Blocks, 10 cwt. to 10 tons.—Progressive Engineering Company, Limited, Leicester.

PATTERN MAKING, wood and metal for engineers, motor, and other trades: keen prices, accurate work, and quick delivery.—The Rolfe Pattern Making Company, 106, Rolfe Street, Smethwick

ENQUIRIES SOLICITED FOR CASTINGS IN IRON, machined or unmachined, up to 5 cwt. Complete Machines built throughout to specification, singly or in quantity. Jig and Tool Work a speciality.—C. S. Peatfield, Limited, Market Rasen, Lincs.

PATTERNS and CASTINGS SUPPLIED WHICH GIVE SATISFACTION. Inquiries solicited. Quotations by return of post or telephone. You can secure good-class work, reasonable prices, and promptitude in delivery by placing your orders with Videx Pattern Works and Foundry, Huntsworth Mews, Upper Baker Street, London, N.W.1. (Telephone, Paddington 364).

WILD & DABER, LIMITED, Engineers and Brassfounders, Weaste.—For SALE, as a going concern, the Freehold Land and Buildings, covering nearly 800 square yards, together with Machinery, Plant and Tools; Electric Power.—For further particulars, apply by letter only to the Receiver for Debenture Holders, Vernon Walker, Lloyds Bank Buildings, King Street, Manchester.

FOR SALE.—Belgian and Luxemburg Pig-iron, in all qualities, also Steel Billets and Blooms. Enquiries solicited.—Elias Wild & Sons, Limited, 180, Piccadilly, London, W.

BUCKINGHAM BROS., Metal and Wire Workers, Warwick Road, Luton. Makers of Moulders' Sieves and Riddles. New bottoms put in old rims. Please send for quotation.

PATENTS.

ADVICE and Handbook Free. — King's Patent Agency, Limited, Director, B. T. King, Reg. Patent Agent, 146a, Queen Victoria Street, E.C.4.

IGNORE THE REST, 1
USE THE BEST:—
"LINICORE"
Write for Sample and Money-saving quotation to
BARTOLINE (HULL) LTD.,
OIL REFINERS, HULL.